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Fish biology

GROWTH RATE OF BLEAK, *ALBURNUS ALBURNUS* (L., 1758) IN MIĘDZYODRZE WATERS

SZYBKOŚĆ WZROSTU UKLEI *ALBURNUS ALBURNUS* (L., 1758) Z WÓD MIĘDZYODRZA

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The rate growth of bleak in Międzyodrze—the wetland located in the lower course of the Odra River above Szczecin—was estimated with use of back-calculations. The fish reaches 59.3 mm in length in the first year of life, 89.1 in the second year, 115.8 mm in the third, and 131.5 mm in the fourth year of life (*SL*). Females are on the whole larger than males of the same age.

INTRODUCTION

The proper fish stock management in the waters of the to "Lower Odra Valley Landscape Park" requires in-depth studies on these stocks. Those of the species which are not targeted by commercial fisheries in these waters—such as the bleak—are not studied as deeply as other demanded species. The information gap concerning the bleak also results from the difficulty to obtain enough research material, as the species sporadically appears in commercial fishery, which uses too large mesh size in the nets to catch the small fish. The experimental catches with use of a small-mesh seine (Kompowski 1998) showed that the bleak is very common in the waters, as it made up about 40% of the total catch. A number of reference literature describe the bleak—feeding on zooplankton and on insects caught from above the water surface—as a competitor for the young stages of most species which are important for commercial catches (Kugel 1942; Terlecki et al. 1977; Vollestad 1985; Chappaz et al. 1987; Boroń and Boroń 1989; Białokoz 1990, 1997; Politou et al. 1993; Terlecki 1993). On the other hand, the bleak itself is a prey species for those predators which are highly demanded in commercial catches, e.g. pike-perch (Krzykawski and Szypuła 1982; Winkler 1989).

Although there are papers on the growth rate of adult bleak in various water bodies across Europe (e.g. Kugel 1942; Chitravadivelu 1971; Biró 1975; Wohlgemuth 1979; Backe-Hansen 1982; Młyniec 1986; Chappaz et al. 1987), or its larvae (Krzykawski 1968), or fry (Wilkońska and Żuromska 1983), there are no published data referring to the growth rate of bleak in the Odra and its drainage area. This paper is aimed at determination of the growth rate of bleak in Międzyodrze waters, which consist of the Regalica, West Odra and the canals connecting these river branches.

MATERIAL AND METHODS

The bleak for the present study were collected during a rather long period of time: 1993–1998. Typical fishing gear (traps, trammel nets) gave rather poor results due to their large mesh size (corresponding with current regulations). Their usage however, permitted was occasional collection of a small number of bleak, which in most cases were of relatively large size (Tab. 1). Not until a specially constructed small-mesh seine was used (wing-span 10 m, mesh size 20 mm in the wings, 10 mm in the codend), was it possible to get good results, and 405 bleak of different size were caught. The material was appended with 27 large bleak caught with a fishing rod.

The fish were preserved in 4% solution of formalin immediately after the catch. The subsequent examination took place in the laboratory. Standard length (*SL*) was measured to 1 mm, total weight to 0.1 g. Scales for age and growth studies were taken from a place above the lateral line, between the rear edge of the pectoral fin and the beginning of the dorsal fin base. Age readings and growth zone measurements, the latter carried out along the caudal radius of the scale, were done with use of a microfiche reading projector, magnifying the image 17.5 times. The sex of the fish was determined by examining their gonads under a dissecting microscope.

The back readings were carried out on the basis of the scale radius vs. fish length relationship curve (Fig. 3), first by reading from the graph the scale radius which reflected the given fish length. Next, the radius value was divided by the actual radius value for the given fish. The ratio so obtained was then treated as a correction index, and was multiplied by the radius of the given annual growth zone. The length of the fish at a given age, relating to the corrected radius value, was read from the graph.

The significance of differences between the mean lengths of males and females at particular age was tested using the t-Student test.

The breakdown of the examined material number and the studies carried out are presented in Tab. 1.

Table 1

Materials collected and analyses performed

Date	Fishing gear	Standard length (cm)	Age groups	Type of studies						
				Length measurements	Weighing	Sexing	Ageing	Scale measurements	Sclerites counting	Back readings
14 Jun 93	lift net	6.7	I	1	1	1	1	1	—	1
16 Jul 93	trammel net	7.9–9.9	II, III	6	6	6	6	6	—	6
21 Jun 94	trammel net	9.1	II	1	1	1	1	1	—	1
13 Jul 94	trammel net	10.2–10.4	III	2	2	—	2	2	—	2
16 Jul 94	traps	9.1	II	1	1	1	1	1	—	1
27 Mar 95	traps	10.9–12.2	III	3	3	3	2	3	—	2
24 Apr 96	traps	12.3–13.7	III, IV	4	4	4	4	4	—	4
30 Apr 96	traps	12.0–13.3	III, IV	4	4	4	4	4	—	4
23 Jul 96	small-mesh seine	7.5–10.1	II, III	7	7	7	7	7	—	7
25 Jul 96	small-mesh seine	3.0–10.5	0, I, II	20	12	19	19	19	5	19
6 Aug 96	small-mesh seine	1.6–9.4	0, I, II	35	22	18	25	25	19	18
29 Aug 96	small-mesh seine	3.0–9.9	0, I, II	16	16	7	14	14	6	8
5 Sep 96	small-mesh seine	1.7–10.1	0, I	185	16	20	37	37	35	19
24 Sep 96	small-mesh seine	1.7–9.0	0, I	44	12	12	12	12	3	12
18 Oct 96	small-mesh seine	2.1–8.4	0, I	52	51	11	30	30	—	11
13 May 97	small-mesh seine	6.6–10.0	I, II	19	19	19	19	19	—	19
26 Jun 97	small-mesh seine	1.3	0	3	—	—	—	—	—	—
3 Jul 97	small-mesh seine	1.6–9.1	0, II	24	5	5	5	5	4	5
6 Aug 98	fishing rod	10.1–14.4	II, III	15	15	15	15	15	—	15
20 Sep 98	fishing rod	10.7–16.2	I–VII	12	12	12	12	12	—	11
Total		1.3–16.2	0–VII	454	209	165	216	217	72	165

RESULTS

Body length structure and age of the bleak caught with small-mesh seine

Tab. 2 presents the length frequency distribution of bleak grouped into 5-mm length classes. Among the fish caught between the end of July and the beginning of August 1996 (23 Jul–6 Aug), two distinct groups could be seen: the first group comprised tiny fish of 15–30 mm, and the second group consisted of larger fish, 55–105 cm in body length. Two distinct size groups could also be seen in the catches carried out from the end of August till the beginning of September 1996 (29 Aug–5 Sep), this time however the smaller group (15–40 mm) had two clear peaks. The first peak was on account of the fish of 20 mm in modal length, and the second resulted from the presence of the specimens of 30 mm in modal length. The second group consisted of the fish of 70–95 mm in length. The bleak collected from the autumn catches in 1996 (24 Sep–18 Oct) featured a similar size struc-

ture. It is interesting that, in spite of the late season of the year, still very small fish, 15–25 mm long, were present in the first group.

Table 2

Length of bleak caught by means of small-mesh seine

SL mm	23 Jul–6 Aug 1996	29 Aug–5 Sep 1996	24 Sep–18 Oct 1996	13 May 1997	26 Jun–3 Jul 1997	Total
15	4	2	2		13	21
20	6	21	26		9	62
25	6	15	5			26
30	2	73				75
35		50				50
40		13				13
45						0
50			1			1
55	4					4
60	7		7			14
65	5		12	1		18
70	3	1	13	7		24
75	7	6	10	4		27
80	5	9	7	2	1	24
85	2	4	10	2		18
90	4	5	3	1	4	17
95	4	2		2		8
100	2					2
105	1					1
Total	62	201	96	19	27	405

In the catches done in May 1997 (13 May), only the second size group was present, consisting of the fish of 65–95 mm. Not until the end of June–beginning of July 1997 (26 Jun–3 Jul) did smaller fish appear, when 3 specimens of 13 mm were caught on 26th June and 19 fish of 16–20 mm were caught on 3rd July (Tab. 2).

The scale study revealed that the annual rings are formed on the edge in July. The fish caught in April, May, and June did not have a visible ring, whereas all the fish caught in August had a clear annual ring and a narrow increment around it.

The scale study also showed that the fish in the first size group (15–40 mm) entirely belonged to age group 0, and those in the second size group were of age groups I and II.

Similarly as in the catches of 1996, also in 1997 the first size group contained age group 0 specimens only, and the second group was composed of age groups I and II.

The wide range of length within age group 0 fish indicated a long, extended in time spawning period. The first postlarval specimens of *SL* = 13 mm appeared as early as on 26th June, whereas small fish of 17–23 mm in length were still present in autumn (24 Sep). The long-lasting, batch character of spawning was clearly demonstrated by the length com-

position of age group 0 caught between 29th August and 5th September 1996. The clear bimodality of the length distribution in this age group indicates that the spawning consists of at least two portions. Thus, towards the end of summer one part of the young bleak of age group 0 is about 40 mm long, whereas at the end of September some specimens are still of 20 mm in length on the average. The question arises, whether there are any chances for such undersized fish to survive until the following spring.

Length and age of bleak caught with other gears

Among the bleak caught by means of trammel nets, traps, lift nets, and a fishing rod, the specimens were older than in the case of the small-mesh seine. There were no fish of age group 0 present, and the dominant were the fish of age groups II and III. They were generally longer than 90 mm (Tab. 1). One specimen caught with a fishing rod on 20th September 1998 in the Odyniec canal was a female of *SL* = 162 mm, weighing 52.8 g. The age of the fish was 7 years.

The number of sclerites

The growth of the scales can be described observing the gradual increment of the number of sclerites. The smallest bleak from which it was possible to collect scales were 25 mm in *SL*. There were 6–7 sclerites on the scales of these fish. The fish in 30 mm length class had 5–17 sclerites on their scales. The scales of the fish of 60 mm had 24–35 sclerites, and there were 55–76 sclerites on the scales of the fish in 95 mm length class. The first annual increment zone (from the centre to the first annual ring) comprised 15–49 sclerites, on the average 29.81 ±7.55 (n = 37).

Fig. 1 presents the relationship between the body length (*SL*) and the number of sclerites (N_S). It is a curvilinear relationship, and can be described with the following power equation:

$$N_S = 0.0236\ SL^{1.7509}$$

The relatively high coefficient of determination, $R^2 = 0.9484$, indicates that the correlation is strong. The curvilinearity of this relationship results from the fact that the farther from the scale centre towards the edge, the narrower become the intervals between the sclerites. The curve described with the above equation has a drawback, however, as it runs from the origin of the co-ordinate system, which makes it impossible to estimate the length of the fish at the moment of scale creation, i.e. when the number of sclerites equals 0. The following linear equation:

$$N_S = 0.8623\ SL - 17.169;$$

fits the empirical data slightly worse ($R^2 = 0.9143$). When calculated according to the linear equation, the theoretical bleak length at which scales appear equals 19.91 mm.

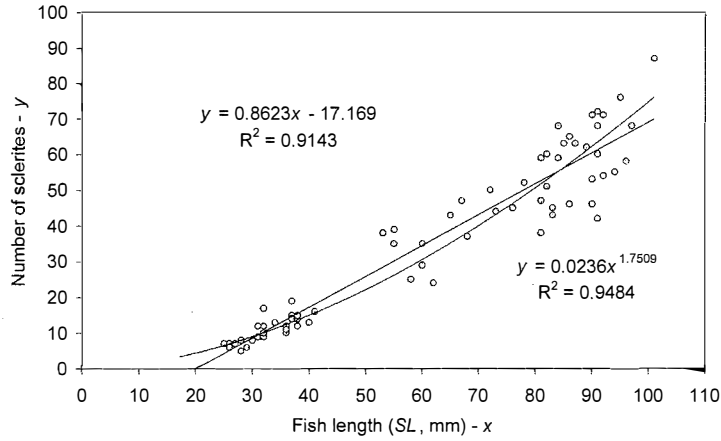

Fig. 1. Relationship between number of sclerites on scale and body length (*SL*) in bleak in the Międzyodrze waters

Fig. 2 presents another approach in the estimation of the length at the moment of scale formation, this time using the relationship between the length and the number of sclerites for the fish belonging to age group 0 only. The following linear equation was derived:

$$N_S = 0.6529\ SL - 10.418;\ R^2 = 0.6764$$

This regression, statistically significant at the confidence level 0.001, provides the possibility to estimate the length at scale formation as 15.96 mm. The above equations also enable the reconstruction of the length of a bleak swallowed by a predator, on the basis of the number of sclerites on the scales found in the predator's alimentary track.

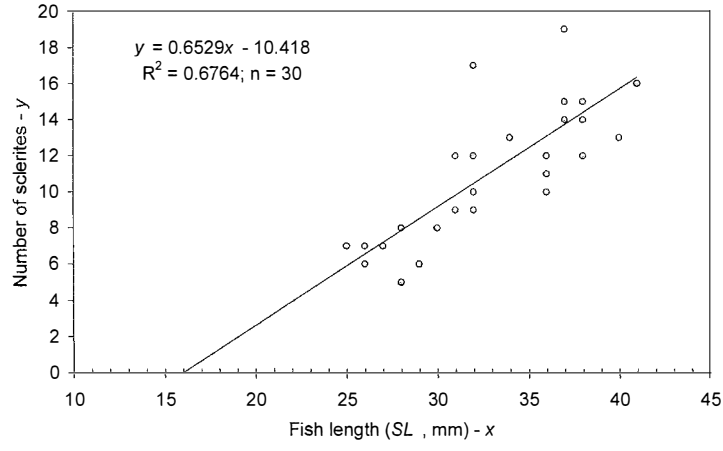

Fig. 2. Relationship between number of sclerites on scale and body length (*SL*) in 0 age group bleak in the Miedzyodrze waters

Relationship between caudal scale radius and body length

The relationship between the length of the caudal scale radius (magnified 17.5 times) and the standard length of bleak is presented in Fig. 3. The graphic representation of this relationship is slightly curvilinear, which can be well described by the following equation:

$$SL = 2.1801\ V^{1.0332} + 10.673;$$

where: *V*—length of scale caudal radius (mm × 17.5), *SL*—standard length of fish (mm).

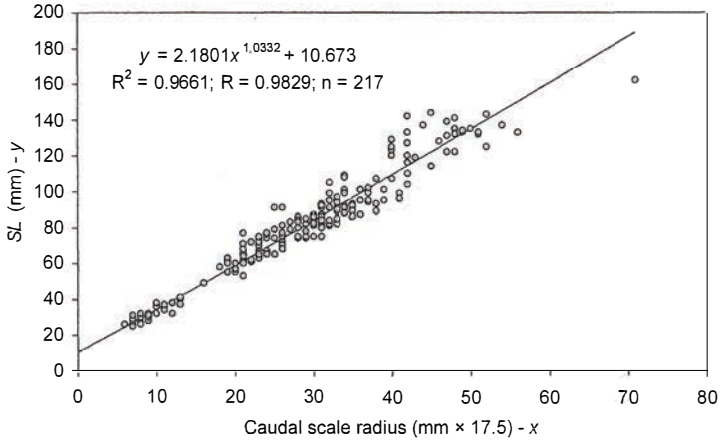

Fig. 3. Relationship between caudal scale radius and body length (*SL*) in bleak in the Międzyodrze waters

The high value of the coefficient of determination, $R^2 = 0.9661$, indicates a strong correlation and shows that the model fits well the empirical data. According to the equation, the theoretical length at which scales appear on bleak is 10.6 mm. This value is about 10 or 6 mm lower than the value derived from the relationship between the length and the number of sclerites. It is also more reliable than the value estimated as in the previous chapter, as the studied relationship was based on the numerous sample of 217 measurements, which did not deviate considerably from the theoretical curve.

Growth rate

Tab. 3 presents the average lengths of bleak attained in the consecutive years of life, reconstructed with back readings from scales. The data in the table are based on the growth reconstruction of 66 males, 79 females, and 19 specimens for which it was impossible to determine sex due to their low level of gonadal development. The length span of the bleak belonging to the particular age groups is wide, especially in the first year of life, where the upper limit of the length range (84.5 mm) is twice as high as the lower limit of the range (41.0 mm).

Table 3

Mean lengths (*SL*, mm) in particular age groups of bleak from the Międzyodrze waters reconstructed with back readings method

Age	Number		L_1	L_2	L_3	L_4
1	82	Range	44.7–75.6			
		Mean	57.73			
		±SD	7.21			
2	51	Range	41.0–86.5	72.0–120.6		
		Mean	61.46	87.83		
		±SD	9.27	10.23		
3	27	Range	41.5–84.5	69.0–110.6	95.0–137.0	
		Mean	59.91	91.40	116.00	
		±SD	11.78	12.11	11.46	
4	4	Range	41.7–78.5	74.5–100.0	105.0–125.5	128.0–133.0
		Mean	60.10	89.00	114.30	131.50
		±SD	14.45	9.20	7.74	2.06
Total	164	Range	41.0–86.5	69.0–120.6	95.0–137.0	128.0–133.0
		Mean	59.31	89.06	115.76	131.5
		±SD	9.26	10.98	11.25	2.06
		Number	164	82	31	4
Annual increments			L_1	L_2–L_1	L_3–L_2	L_4–L_3
			59.31	29.75	26.70	15.74

The comparison of the values presented in Tab. 3 reveals that the annual increments, being on the average about 60 mm during the first year of life, decrease sharply in the subsequent years to 30 mm during the second, 25 mm during the third, and 16 mm during the fourth year of life.

The average rate of growth of males is slower than the one of females (Tabs. 4, 5). The difference between the mean length of males and females in the first year of life, 1.2 mm, is not big though statistically significant at the confidence level of 0.001, and rises to 5.7 mm in the second, and to 7.7 mm in the third year of life (Tab. 6), which is still statistically significant at the confidence level of 0.001.

The data on the mean length of bleak at age 4 are not representative, as they are based on only 4 examined specimens, of which 3 were females and 1 was a male.

Growth of body weight with length and age

The relationship between the weight and length of the bleak in Międzyodrze can be described in the form of the following power equation:

$$W = 0.0134\ SL^{2.947};$$

where: *W*—total body weight in g, *SL*—standard length of fish in mm.

The high value of the coefficient of determination, $R^2 = 9.979$, displays a good fit of the model to the empirical data.

Table 4

Mean lengths (*SL*, mm) in particular age groups of male bleak from the Międzyodrze waters reconstructed with back readings method

Age	Number		L_1	L_2	L_3	L_4
1	32	Range	45.0–73.5			
		Mean	58.86			
		±SD	7.11			
2	23	Range	41.0–75.0	72.0–100.0		
		Mean	60.27	86.35		
		±SD	8.44	8.86		
3	10	Range	41.5–84.5	69.0–109.5	97.5–132.5	
		Mean	57.60	87.40	112.10	
		±SD	13.96	11.88	11.06	
4	1	Mean	69.0	100.0	109.5	132.0
Total	66	Range	41.0–84.5	69.0–109.5	97.5–132.5	—
		Mean	59.31	87.06	111.86	132.0
		±SD	8.78	9.66	10.04	—
		Number	66	34	11	1

Table 5

Mean lengths (SL, mm) in particular age groups of female bleak from the Międzyodrze waters reconstructed with back readings method

Age	Number		L_1	L_2	L_3	L_4
1	39	Range	45.5–75.6			
		Mean	57.55			
		±SD	6.92			
2	22	Range	48.5–86.5	75.0–12.6		
		Mean	65.30	92.19		
		±SD	10.04	10.41		
3	15	Range	43.5–80.5	73.0–110.5	95.0–137.0	
		Mean	61.80	95.08	120.33	
		±SD	11.56	12.53	10.92	
4	3	Range	41.7–78.5	74.5–91.5	105.0–125.5	128.0–133.0
		Mean	57.13	85.33	115.67	131.33
		±SD	19.10	9.41	10.28	2.89
Total	79	Range	41.7–86.5	73.0–120.6	95.0–137.0	128.0–133.0
		Mean	60.50	92.76	119.56	131.33
		±SD	9.73	11.07	10.37	2.89
		Number	79	40	18	3

Table 6

Comparison of mean lengths at particular ages of male and female bleak from the Międzyodrze waters. Significance of differences was tested at 0.01 and 0.001 confidence levels using t-Student test

Age	Number		Mean length (mm)		Difference	t	t tabular	
	♂	♀	♂	♀			0.01	0.001
1	66	79	59.31	60.50	1.19	6.7630	2.576	3.291
2	34	40	87.06	92.76	5.70	10.0959	2.660	3.460
3	11	18	111.86	119.56	7.70	3.8037	2.771	3.690

The mean body weights of bleak in the consecutive years of life, obtained by substitution of the mean lengths in the consecutive years of life to the length–weight relationship, are presented in Tab. 7. These data show that the increments in weight are considerable in the second and third year of life, although the increments in length are minor at this age.

Table 7

Mean weights (g) at particular ages of bleak from the Międzyodrze waters

Sex	Age – years			
	1	2	3	4
Males	2.54	7.88	16.50	26.88
Females	2.70	9.50	20.08	26.48
Total	2.54	8.43	18.26	26.58

DISCUSSION

The spawning of bleak is of batch character and is extended in time. In the water bodies of Central Europe, it takes place mainly in June (Kugel 1942; Krzykawski 1968), however it can begin in May and last through to August (Wilkońska and Żuromska 1977). The author of this paper has observed a number of times bleak spawning during the second half of July in various water bodies in the vicinity of Szczecin. The long-lasting, batch spawning can explain the presence of small-size bleak specimens, 15–25 mm in length, spotted as late as at the end of September and in October. The question arises, whether the tiny fry has any chances to survive until the following spring.

The smallest immature bleak that were available for the author of this paper, three specimens of *SL* = 13 mm (*TL* about 16 mm), were caught in the waters of Międzyodrze on 26 June 1997. They had formed all their fins. If we suppose that the growth rate of the bleak larvae in the Międzyodrze waters is comparable to the growth rate of the bleak larvae in lake Legińskie in Masurian Lake District (Krzykawski 1968), the age of these three specimens can be estimated as approximately 20 days. Assuming also after Krzykawski

(1968) that the incubation of eggs takes 3–5 days, it can be accepted that the studied specimens developed from the eggs laid during the first days of June.

According to my observations, the annual rings on the scales of bleak are formed in July. This corresponds with the findings by Backe-Hansen (1982) who studied bleak in lake Øyeren in south-east Norway and noticed that the rings—both on scales and otoliths—are formed on the beginning of July. Chappaz et al. (1987) reported that the annual rings on the scales of bleak in St-Croix dam reservoir, on the river Verdon, are formed in June. Thus, it is not appropriate to use the term "winter rings" in respect to the annual rings (see e.g. Kugel 1942).

The first annual increment zone comprised 15–49 sclerites. This range was wider than in the case of the lake Balaton bleak, which was reported by Biró (1975) to have 15–25 sclerites.

Most researchers (Chitravadivelu 1970; Biró 1975; Chappaz et al. 1987) observed linearity of the relationship between the length of scale radius and the body length of bleak. Similar in character was the relationship between body length and otolith length (*centrum–antirostrum*). This is not however in contradiction to the data presented in this paper, when we take into account that the relationship described here is only slightly curvilinear. The point where the curve crosses the co-ordinate system axis, i.e. the (theoretical) length at which scales begin to form, differ as reported by different authors. According to Biró (1975) it is 8.69 mm, Chitravadivelu (1970) reported 16.0 mm, and Wohlgemuth (1979) used, after Vostradovsky (1963), the value of 20 mm for his calculations (in all cases *SL*). Thus either the length 10.7 mm, as obtained here from the relationship between the scale radius and *SL*, or the lengths 15.96 mm and 19.91 mm, as estimated according to the number of sclerites versus *SL*, can be located between the limits given in the reference literature. To fully illustrate the comparison, it should be stated that both Biró (1975) and Chitravadivelu (1970) collected the scales from the same place of the body as the author of this paper.

For the purpose of comparison, the growth rate of bleak from various water bodies is presented in Tab. 8. The bleak in lake Øyeren in south-east Norway (Backe-Hansen 1982) belong to the ones with the slowest growth rate, as well as the bleak in lake Legińskie (Młyniec 1986) and in lake Balaton (Biró 1975). The fastest growing bleak, among the compared water bodies, live in the dam reservoir near Brno (Wohlgemuth 1979). The bleak population in Międzyodrze can be classified in the middle, being of medium growth rate, the most similar to the bleak population in the river Frisching, running into the Vistula Lagoon, and the river Beek, running into the Kuronian Lagoon (Kugel 1942).

Table 8

Growth rate of bleak *Alburnus alburnus* (L., 1758) in some bodies of water (*SL*, mm)

Water body	Sex	L_1	L_2	L_3	L_4	L_5	L_6	L_7	L_8	Source
River Beek*	♂	59.8	90.2	114.8						Kugel 1942
	♀	58.8	93.3	126.0	137.9					
	♂, ♀	47.8	91.8	124.4	137.9					
River Frisching*	♂, ♀	47.0	91.9	122.7	133.9					
Sainte-Croix Dam Reservoir**	♂	42.9	71.0	98.1	113.1	124.3	137.4	144.9		Chappaz *et al.* 1987
	♀	48.5	78.5	110.3	126.2	137.4	148.6	161.7		
Lake Øyeren*	♂, ♀	38.0	68.1	87.3	99.9	108.2	114.9	122.5	129.2	Backe-Hansen 1982
River Labe near Děčin	♂, ♀	48.0	75.0	96.0	115.0	128.0	142.0	151.0		Chitravadivelu 1971
River Vltava near Méchenice	♂, ♀	52.0	78.0	94.0	105.0	135.0	161.0			
River Vltava near Podbaba	♂, ♀	54.0	87.0	110.0						
River Ohře near Karlovy-Vary	♂, ♀	50.0	83.0							
Stream Stropnice	♂, ♀	49.0	68.0	74.0						
Brno Valley Reservoir	♂, ♀	70.2	122.3	148.8	164.5	170.9				Wohlgemuth 1979
Lake Legińskie	♂, ♀	—	76.0	79.0	99.0	101.0	116.0	117.0		Młyniec 1986
Lake Balaton	♂, ♀	43.0	60.0	71.0	81.0	98.0	106.0			Biró 1975
Międzyodrze	♂	59.3	87.1	111.9	132.0					Kompowski, present paper
	♀	60.5	92.8	199.6	131.3					
	♂, ♀, 0	59.3	89.1	115.8	131.5					

* *TL* in the original, converted into *SL*

** *FL* in the original, converted into *SL*

The sex dependent difference of the growth rate was for the species reported by Kugel (1942) and Chappaz et al. (1987). Their observations correspond with the results of these studies, i.e. the mean female length is greater than the mean length for males, and the difference is statistically significant.

CONCLUSIONS

1. In the catches carried out with the small-mesh seine, two size groups were present: the first of 15–40 mm in *SL* comprised the fish belonging to age group 0 only, the second group of 55–105 mm consisted of fish in age groups I and II. The bleak caught with a lift net, trammel nets, and traps, as well as with a fishing rod, belonged mainly to age groups II and III.
2. The number of scale sclerites is quite strongly correlated with fish length (*SL*), which allows to estimate the theoretical length of scale formation as 19.91 or 15.96 mm.
3. The relationship between the length of caudal scale radius ($V \times 17.5$, in mm) and the body length (*SL*) is slightly curvilinear, and can be described with the equation: $SL = 2.1801\ V^{1.0332} + 10.673$. According to this equation, the theoretical body length of bleak (*SL*) at which scales are formed is 10.7 mm.
4. The bleak in Międzyodrze attain on the average 59.3 mm in length in the first year of life, 89.1 in the second, 115.8 in the third, and 131.5 mm in the fourth year of life. The range of variation in the body length is considerable, probably due to the extended in time spawning period.
5. The average growth rate of males is significantly faster than the average growth rate of females.
6. The relationship between the length (*SL*) and weight (*W*) can be described according to the following equation: $W = 0.0134\ SL^{2.947}$.
7. The population of bleak in Międzyodrze can be classified as growing with a medium rate in respect to other European populations of the species.

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SZYBKOŚĆ WZROSTU UKLEI *ALBURNUS ALBURNUS* (L., 1758) Z WÓD MIĘDZYODRZA

STRESZCZENIE

Zbadano szybkość wzrostu uklei z wód Międzyodrza – obejmujących Regalicę, Odrę Zachodnią oraz sieć kanałów i starorzeczy łączących te dwa ramiona.

W połowach przeprowadzonych drobnooczkowym włoczkiem narybkowym (rozpiętość skrzydeł 10 m, wielkość oczka w skrzydłach 20 mm, w matni 10 mm) występowały dwie grupy wielkościowe – pierwsza o długości ciała (*SL*) 15–40 mm zawierała wyłącznie ryby należące do 0 grupy wieku, druga o długości 55–105 mm to ryby należące do I i II grupy wieku. Ukleje złowione podrywką, drgawicami, pułapkami oraz przy pomocy wędki należały przede wszystkim do II i III grupy wieku.

Stwierdzono istnienie dość silnej korelacji między liczebnością sklerytów na łusce i długością ryby. Zależność między długością promienia kaudalnego łuski ($V \times 17{,}5$ – mm) i długością standardową (*SL* – mm) ryby jest lekko krzywoliniowa i można ją przedstawić przy pomocy równania: $SL = 2{,}1801\ V^{1{,}0332} + 10{,}673$.

Ukleje z Międzyodrza osiągają przeciętnie w pierwszym roku życia 59,3 mm, w drugim 89,1 mm, w trzecim 115,8 i w czwartym 131,5 mm, zaś średnie ich masy wynoszą odpowiednio: 2,54 g, 8,43 g, 18,26 g i 26,58 g. Samice w tym samym wieku są przeciętnie nieco większe od samców, a różnice te są istotne statystycznie. Zależność między długością ciała (*SL* – mm) i masą całkowitą (*W* – g) można przedstawić przy pomocy równania: $W = 0{,}0134\ SL^{2{,}947}$.

Ukleja z Międzyodrza rośnie ze średnią szybkością w porównaniu z innymi populacjami uklei.

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