ACTA HYDROBIOL.	14	4	399—418	KRAKÓW 1972

STANISŁAW SKÓRA

Płoć (*Rutilus rutilus* L.) zbiornika zaporowego w Przeczycach

The roach (*Rutilus rutilus* L.) from the dam reservoir in Przeczyce

Mémoire présenté le 6 décembre 1971 dans la séance de la Commission Biologique de l'Académie Polonaise des Sciences, Cracovie

Abstract — The body length, body weight, growth, age, variability of 30 morphological features of the body, variability of meristic features, and fertility of 205 specimens of the roach from the dam reservoir in Przeczyce were examined. Analysis of the content of the alimentary canal of this fish was carried out. The growth of the examined fish in comparison with that of this species in other reservoirs was considered as fair. A decrease and following equalization of relative variability of morphological features is similar to that in other fish. Meristic features did not deviate from the standard adopted for the roach. Individual variations of fertility of females were considerable and ranged from 12480 to 334464 eggs for one female. Larvae of insects and filamentous algae constituted the main components of the content of the alimentary canal of the roach.

The present work on the method of stocking the dam reservoir in Przeczyce was performed within the framework of collective investigations carried out by the Institute of Water Biology of the Polish Academy of Sciences in Cracow. It thus seemed necessary to make a comprehensive study of the roach occurring in great numbers in the mentioned reservoir.

The dam reservoir in Przeczyce came into existence due to damming of the river Czarna Przemsza in the basin of the Upper Vistula. The area of this reservoir amounts to about 400 ha (Wajdowicz 1968) at high water. It is a typical lowland, very shallow reservoir. Wajdowicz (1968) and Klimczyk-Janikowska (1970) give more details concerning this reservoir. Its shallowness will cause it to be permanently overgrow with soft and hard vegetation. It is a moderately fertile reservoir in which eutrophy of the environment proceeds concomitantly with the decay of the dead vegetation deposited on the bottom and with

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mineralization of the slime. The present fish stock in the reservoir consists, according to Klimczyk-Janikowska (1970), of 20 species.

This reservoir is made available to the maximum for angling purposes, while commercial fishing is organized only sporadically.

The number of roach caught commercially has greatly decreased, but the percentage is still high. According to Wajdowicz (1971), in 1965 the roach constituted as much as 60.0 per cent of the total weight of the caught fish, in 1966 only 33.6 per cent, and in 1967 it did not exceed 10.0 per cent.

The aim of the present paper was to acquire some knowledge concerning the roach occurring in the reservoir, to characterize it with respect to age, growth rate, morphology, and biology and to examine the content of its alimentary canal.

Material and method

The material for investigations on the roach population from the dam reservoir in Przeczyce was collected in July and September 1965 and from Aprill to October 1966 (Table I). 205 specimens of the roach from commercial catches performed mostly by means of flyke and set nets constituted the experimental material. Analysis and detailed measurements were, as a rule, carried out every month except for the winter months when the fish were not caught because the reservoir was frozen.

For age determination of the investigated material a few scales were taken from each fish from the first row of scales above the lateral line

Tabela I. Odłowy płoci w zbiorniku zaporowym Przeczyce wykorzystanych w niniejszych badaniach

Table I. Catch of roach in the dam reservoir in Przeczyce used in the present investigations

Data połowu Date of catch	♂		♀		♂♀	
	n	%	n	%	n	%
15.VII. 1965	11	18.64	14	9.59	25	12.20
10.IX. 1965	9	15.25	18	12.33	27	13.17
20.IV. 1966	10	16.95	22	15.07	32	15.61
12.V. 1966	15	25.42	27	18.49	42	20.49
16.VI. 1966	6	10.17	8	5.48	14	6.83
13.VII. 1966	3	5.09	20	13.70	23	11.22
23.VIII.1966	3	5.09	28	19.18	31	15.12
7.X. 1966	2	3.39	9	6.16	11	5.37
Razem - Total	59	100.00	146	100.00	205	100.00

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Tabela II. Średnie arytmetyczne wymiarów ciała w cm ($\bar{x}$) płoci ze zbiornika zaporowego w Przeczycach

Table II. Arithmetical means in cm ($\bar{x}$) of the body sizes of roach from the dam reservoir in Przeczyce

Grupa wieku Age group	IV			V			VI			VII			VIII			IX			X	XI	XII	XIII	XIV	XV	Razem Total		
Liczba badanych ryb Number of examined fish	12	23	35	11	31	42	13	17	30	13	11	24	5	13	18	4	10	14	17	9	8	7	-	1	59	146	205
Płeć Sex	♂	♀	♂♀	♂	♀	♂♀	♂	♀	♂♀	♂	♀	♂♀	♂	♀	♂♀	♂	♀	♂♀	♀	♀	♀	♀		♂	♂	♀	♂♀
Longitudo totalis	17.1	18.4	17.9	19.9	20.7	20.5	24.2	25.0	24.7	26.8	27.2	27.0	28.6	28.9	28.8	30.3	30.8	30.6	31.2	32.1	32.8	33.3		34.9	23.5	26.0	25.2
Longitudo corporis	13.9	15.0	14.6	16.3	17.0	16.8	19.8	20.8	20.2	22.0	22.4	22.2	23.4	23.9	23.8	25.1	25.8	25.6	26.1	26.9	27.6	28.0		29.5	19.3	21.5	20.9
Longitudo praeventralis	6.8	7.4	7.2	7.9	8.3	8.2	9.8	10.3	10.1	10.8	11.0	10.9	11.4	11.6	11.6	12.4	12.4	12.4	12.5	12.8	13.2	13.3		13.6	9.5	10.5	10.2
Longitudo praeanalis	9.8	10.6	10.3	11.5	12.2	12.0	14.3	14.9	14.6	15.8	16.0	15.9	16.5	16.9	16.8	18.0	18.4	18.3	18.6	19.2	19.6	20.0		19.5	13.7	15.3	14.9
Longitudo pedunculi caudae	2.9	3.0	3.0	3.3	3.5	3.4	3.9	4.1	4.0	4.4	4.4	4.4	4.6	4.8	4.7	4.8	5.1	5.0	5.1	5.3	5.3	5.2		6.4	3.9	4.3	4.1
Longitudo trunci	11.1	12.0	11.7	13.1	13.7	13.5	15.9	16.6	16.3	17.7	17.9	17.8	18.6	19.1	19.0	20.1	20.5	20.4	20.8	21.5	22.1	22.4		23.8	15.4	17.2	16.7
Longitudo capitis lateralis	3.1	3.3	3.2	3.6	3.8	3.7	4.2	4.5	4.4	4.7	4.8	4.8	5.2	5.2	5.2	5.2	5.5	5.4	5.5	5.6	5.6	5.8		6.3	4.2	4.6	4.5
Longitudo spatii postorbitalis	1.5	1.6	1.5	1.8	1.8	1.8	2.1	2.2	2.1	2.4	2.4	2.4	2.6	2.6	2.6	2.6	2.7	2.7	2.7	2.8	2.9	3.0		3.0	2.1	2.3	2.2
Diameter oculi	0.8	0.9	0.9	0.9	1.0	1.0	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.3		1.4	1.0	1.1	1.0
Longitudo spatii praeorbitalis	0.9	0.8	0.9	1.0	1.1	1.0	1.2	1.3	1.2	1.4	1.4	1.4	1.5	1.5	1.5	1.4	1.5	1.5	1.5	1.6	1.6	1.6		1.9	1.2	1.3	1.3
Longitudo P	2.6	2.6	2.6	3.0	3.0	3.0	3.4	3.5	3.4	3.8	3.7	3.8	4.2	4.0	4.1	4.3	4.3	4.3	4.3	4.3	4.1	4.5		4.7	3.4	3.6	3.5
Longitudo V	2.5	2.6	2.6	2.9	3.0	3.0	3.4	3.6	3.5	3.9	3.8	3.8	4.2	4.2	4.2	4.4	4.3	4.4	4.3	4.4	4.4	4.6		5.2	3.4	3.6	3.6
Summa altitudo A	2.1	2.3	2.2	2.4	2.4	2.4	2.8	2.8	2.8	3.2	3.0	3.1	3.4	3.3	3.4	3.5	3.5	3.5	3.5	3.6	3.8	3.7		4.0	2.8	3.0	2.9
Summa altitudo D	3.1	3.4	3.3	3.6	3.5	3.5	4.0	4.1	4.0	4.5	4.4	4.5	5.0	4.8	4.8	5.3	5.1	5.2	5.1	5.1	5.4	5.4		5.8	4.1	4.3	4.3
Longitudo pinnae C superior	3.3	3.5	3.5	3.6	3.9	3.8	4.4	4.6	4.5	5.0	5.0	5.0	5.4	5.3	5.3	5.5	5.6	5.5	5.6	5.8	6.0	6.2		5.9	4.4	4.8	4.7
Longitudo pinnae C inferior	3.4	3.7	3.6	3.8	4.0	3.9	4.5	4.6	4.6	5.0	5.1	5.0	5.5	5.4	5.4	5.6	5.6	5.6	5.7	5.8	6.0	6.2		5.8	4.4	4.9	4.7
Longitudo pinnae C media	1.4	1.5	1.5	1.5	1.7	1.6	1.8	1.8	1.8	2.0	2.0	2.0	2.2	2.1	2.1	2.3	2.1	2.2	2.1	2.2	2.3	2.7		2.2	1.8	1.9	1.9
Longitudo basis D	2.1	2.2	2.1	2.6	2.5	2.5	2.9	3.0	3.0	3.3	3.3	3.3	3.5	3.3	3.3	3.7	3.7	3.7	3.8	3.8	4.0	4.1		4.1	2.9	3.1	3.0
Distantia praedorsalis	7.2	7.7	7.5	8.6	8.9	8.8	10.1	10.7	10.4	11.3	11.6	11.4	12.1	12.4	12.3	12.9	13.2	13.0	13.0	13.2	13.7	14.1		14.5	9.9	11.0	10.7
Distantia postdorsalis	5.3	5.9	5.6	6.3	6.5	6.4	7.5	7.9	7.7	8.4	8.4	8.4	8.9	9.2	9.1	9.3	10.0	9.7	10.0	10.4	10.3	10.5		11.6	7.3	8.2	7.9
Spatium inter P et V	3.7	4.0	3.9	4.2	4.5	4.4	5.4	5.7	5.6	5.9	6.2	6.0	6.3	6.6	6.5	6.6	7.1	6.9	7.2	7.5	7.6	7.7		7.9	5.1	5.9	5.7
Spatium inter V et A	3.4	3.6	3.5	4.1	4.3	4.2	5.0	5.3	5.2	5.3	5.8	5.4	5.7	6.1	6.0	6.3	6.7	6.6	6.7	6.9	7.0	7.2		7.2	4.7	5.5	5.3
Longitudo basis A	1.6	1.7	1.7	2.0	2.0	2.0	2.4	2.4	2.4	2.7	2.7	2.7	2.9	2.8	2.8	3.1	3.0	3.0	3.0	3.2	3.2	3.3		3.6	2.3	2.5	2.5
Summa altitudo capitis	2.4	2.5	2.5	2.9	2.9	2.9	3.5	3.7	3.6	3.9	3.9	3.9	4.3	4.1	4.2	4.5	4.4	4.4	4.5	4.6	4.8	4.8		5.4	3.4	3.7	3.6
Summa altitudo corporis	4.4	4.7	4.6	5.3	5.5	5.5	6.6	7.0	6.8	7.2	7.7	7.4	8.2	8.3	8.3	8.5	8.8	8.7	9.0	9.2	9.4	9.6		10.5	6.4	7.2	7.0
Minima altitudo corporis	1.4	1.4	1.4	1.6	1.7	1.7	1.9	2.0	2.0	2.2	2.2	2.2	2.4	2.3	2.4	2.4	2.5	2.5	2.5	2.6	2.6	2.7		2.9	1.9	2.1	2.0
Latitudo frontis	1.1	1.2	1.2	1.5	1.5	1.5	1.9	1.8	1.8	2.0	2.0	2.0	2.2	2.1	2.1	2.4	2.2	2.3	2.3	2.3	2.3	2.5		2.5	1.8	1.9	1.9
Summa latitudo corporis	1.8	2.0	1.9	2.3	2.4	2.3	3.0	3.1	3.0	3.3	3.3	3.3	3.5	3.7	3.6	3.9	3.9	3.9	4.0	4.1	4.1	4.3		4.6	2.8	3.2	3.1
Summa longitudo in circuitu	10.8	11.5	11.3	13.0	13.4	13.3	16.2	17.1	16.7	17.8	18.6	18.2	19.7	20.0	19.9	20.4	21.2	20.9	21.5	21.7	22.3	23.1		25.7	15.6	17.5	16.9
Pondus in g	56.7	70.5	65.8	95.5	105.4	102.9	173.7	199.8	188.5	236.1	263.7	248.8	296.4	322.8	315.4	360.5	386.9	379.3	402.4	423.2	461.1	495.3		610.0	179.5	253.8	232.4

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at the height of the first rays of the dorsal fin. Linear measurements of the body were made with accuracy to 1 mm by means of a slide caliber; the body weight of the roach was determined with accuracy to 1 g by means of a balance. Next, sex and sexual maturity level were determined, the latter according to Nair's scale. Alimentary canals were also extracted and placed in labelled test tubes filled subsequently with some preserving fluid.

The age of the examined material and content of the alimentary canal were determined in the Ichtiological Laboratory of the Institute of Water Biology of the Polish Academy of Sciences in Cracow.

Biometric investigations were carried out according to the scheme accepted in the author's previous paper (Skóra 1964).

In commercial catches organized sporadically in 1965 and 1966 in the dam reservoir in Przeczyce 4—15 year old roach were caught with body length 12.6—29.5 cm and body weight 43—610 g.

The body length of 4—15 year old males and 4—13 year old females ranged from 12.8 to 29.5 cm and 12.6 to 28.9 cm respectively.

It is seen from Table II that the following age groups were the most frequent: V (20.49%), IV (17.07%), VI (14.63%), VII (11.71%) — forming altogether 63.90 per cent of the total number of fish caught. Specimens of more advanced age (age groups VIII to XV) constituted, however, a fairly high percentage, amounting to 36.10 per cent. Specimens in the age group I—III were not encountered in commercial catches because nets of a mesh appropriate for catching smaller fish were not available. In these catches, the percentage of specimens born between 1958—1961 was the highest, i.e., fish born either still in the river or in the first year after the filling of the reservoir with water.

In the analysed roach population female specimens were decidedly in the majority, their percentage reaching as much as 71.2 per cent. A still higher percentage of females equalling, on the average, 85.0 per cent was found in the roach population in the Zalew Wiślański. This percentage does not change much in dependence on the time fishing was carried out, though it varies (as was the case with the roach from Zalew Wiślański investigated by Romański 1963) with respect to individual age groups. In the discussed material in the age group VII the number of males exceeded that of females by one specimen, while in age group XV the only fish caught was a male.

Growth of roach

The rate of growth of male and female roach from the dam reservoir in Przeczyce caught in the years 1965—1966 is shown in Table II. It was determined on the basis of measurements of specimens belonging to

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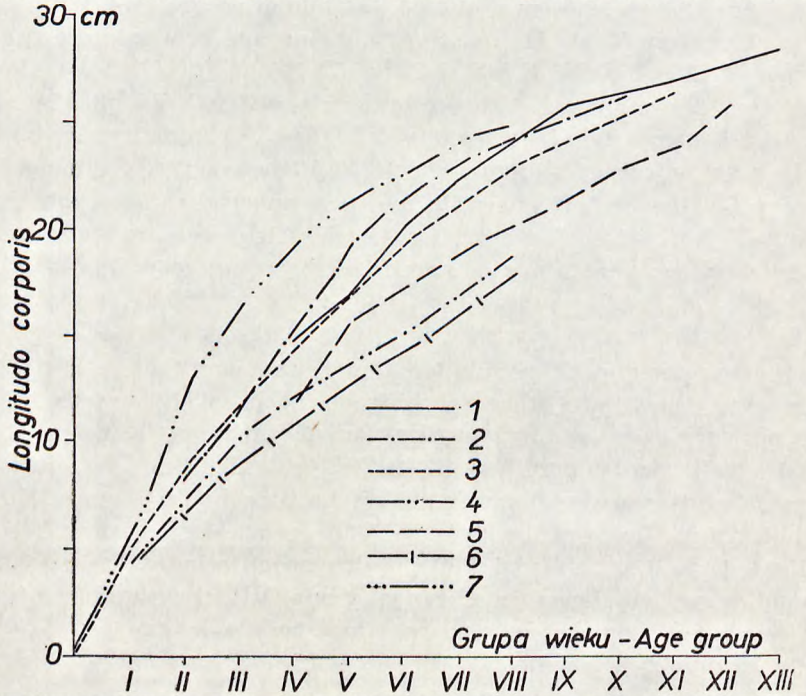
various age groups. A comparison of body length and body weight of male and female roach showed small but distinct differences. The growth rate of the males in the dam reservoir in Przeczyce is slightly lower than that of females. The difference in growth in length of the examined male and female roach within 6 compared age groups varied, on the average, from 1.79 to 7.33 per cent, while the comparison of differences in body weight showed a higher percentage, ranging from 6.82 to 19.57 per cent. Unequal growth with regard to sex was recorded for the roach from the dam reservoir in Goczałkowice (Skóra 1964) and Kozłowa Góra (Skóra 1964a) situated in the same region of Poland. This observation concerns also other species of fish, such as, e.g., crucian carp (Skóra 1961), tench (Norquist 1928, Starmach 1951, Skóra 1964b), and perch (Shafi, Maitland 1971).

A very high growth rate characterized of the roach from the dam reservoir in Przeczyce in comparison with that of the same species in other water reservoirs (figs. 1, 2), this indicating favourable environmental



Ryc. 1. Wzrost długości ciała (*longitudo corporis*) płoci w zbiorniku zaporowym Przeczyce i innych jeziorach

Fig. 1. Increase in body length (*longitudo corporis*) of the roach in the Przeczyce Reservoir and in other lakes.

1. Przeczyce, 2. Goczałkowice (Skóra 1964), 3. Goczałkowice (Skóra 1970), 4. Wdzydze (Zawisza, Karpińska-Waluś 1961), 5. Kozłowa Góra (Skóra 1964a), 6. Średnia z 22 jezior węgorzewskich. Mean from 22 lakes Węgorzewo (Karpińska-Waluś 1961), 7. Kličavi (Holčik 1967)

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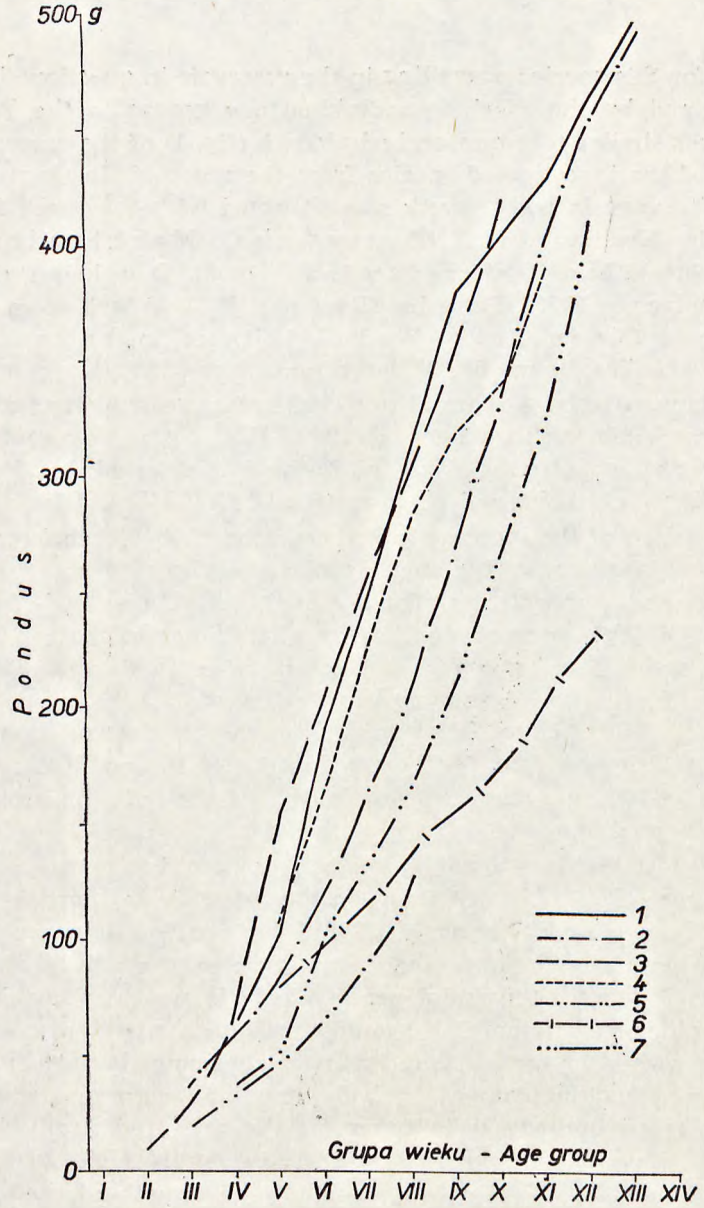

Ryc. 2. Wzrost ciężaru ciała (*pondus*) w zbiorniku zaporowym Przeczyce i innych jeziorach. 1. Przeczyce, 2. Zalew Wiślany (Romański 1963), 3. Goczałkowice (Skóra 1964), 4. Goczałkowice (Skóra 1970), 5. Wdzydze (Zawisza, Karpińska-Waluś 1961), 6. Zalew Szczeciński (Neuhaus 1963), 7. Kozłowa Góra (Skóra 1964a)

Fig. 2. Increase in body weight of the roach in the Przeczyce Reservoir and in other lakes. 1. Przeczyce, 2. Zalew Wiślany (Romański 1963), 3. Goczałkowice (Skóra 1964), 4. Goczałkowice (Skóra 1970), 5. Wdzydze (Zawisza, Karpińska-Waluś 1961), 6. Zalew Szczeciński (Neuhaus 1936), 7. Kozłowa Góra (Skóra 1964a)

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conditions for this species prevailing in the reservoir in question. The body length attained by the roach in individual age groups in the Przeczyce reservoir was similar to the mean body length (fig. 1) of the corresponding age group of the investigated species from the reservoir in Goczałkowice. A smaller increase in body length was observed with the roach from the reservoir in Kozłowa Góra (Dyszewska, Markiewicz 1957, Skóra 1964a), Lakes Tajty (Zawisza 1953), Dowcień, Przetacznik (Stangenberg 1953), Polturba (Balon 1955), as well as in 22 lakes of Węgorzewo (Karpińska-Waluś 1961) and in the Swedish lakes such as, e.g., Lakes Halmajön, Mälaren, and Särnasiön (Kempo 1962), as well as in many others. A similar or even better growth was observed in Lakes Grosser Plöner-See (Geyer 1938, Westphalen 1956), Charzykowo (Stangenberg 1950) and in the dam reservoir in Lipno (Cabejšek, Frank 1968) and Kličova (Holčik 1967).

A comparison of the increase in body weight of the roach from several water bodies is given in fig. 2. This diagram shows 6 comparisons of such waters and demonstrates that the positive increase in body weight of the roach in the reservoir in Przeczyce is similar to that of the same species from the dam reservoir in Goczałkowice (Skóra 1964, 1970). In the other four waters compared in this diagram, i.e. Zalew Szczeciński (Neuhaus 1936), Lake Wdzydze (Zawisza, Karpińska-Waluś 1961), Zalew Wiślany (Romański 1963) and Kozłowa Góra (Skóra 1964a) the increase in body weight of the roach was considerably smaller.

The greatest increase in body weight was recorded between the fifth and ninth year (Table II), while, e.g. in the reservoir in Lipno in Czechoslovakia (Cabejšek, Frank 1968), the greatest increase in body weight begins from the 6th and actually from the 8th year. In the reservoir in Przeczyce the main increase in body weight also takes place only with older roach; this fish should thus be fished after reaching the age of 5 or rather 6 years. Fishing younger specimens is not advisable as the relatively fast increament in body length is accompanied by only a small increase in body weight, e.g. at the age of 4 years the roach attains on the average 12.6 to 16.2 cm in body length/ 15.6—20.0 cm total length, but only 43—87 g in body weight. The growth of the examined roach from the fourth year to the ninth year of age, inclusive, is characterized by a certain regularity, i.e. in a given time unit (year) the increment is expressed by similar values, showing a slight decreasing tendency from year to year. The increase in body lenght of the roach from age group IX was already very low and in no case exceeded the value of 1 cm during the whole year.

The values of the nutrition coefficient (fig. 3) were calculated according to Fulton's formula for the total length (*longitudo totalis*) and varied in individual years. Initially a gradual increase in its value is observed in

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Tabela III. Współczynniki zmienności (v%) wymiarów liniowych ciała i ciężaru ciała płoci ze zbiornika zaporowego w Przeczycach

Table III. Coefficients of variability (v%) of linear sizes and body weight of roach from the dam reservoir in Przeczyce

Grupa wieku Age group	IV			V			VI			VII			VIII			IX			X	XI	XII	XIII	Razem Total		
Liczba badanych ryb Number of examined fish	12	23	35	11	31	42	13	17	30	13	11	24	5	13	18	4	10	14	17	9	8	7	59	146	205
Płeć Sex	♂	♀	♂♀	♂	♀	♂♀	♂	♀	♂♀	♂	♀	♂♀	♂	♀	♂♀	♂	♀	♂♀	♀	♀	♀	♀	♂	♀	♂♀
Longitudo totalis	4.87	5.60	6.31	5.49	6.83	6.72	7.55	3.54	5.73	3.83	3.49	3.65	2.83	3.68	3.58	3.65	2.36	2.69	2.83	2.16	1.69	4.34	18.53	20.82	21.12
Longitudo corporis	4.26	5.90	7.80	5.04	4.23	4.45	7.27	3.00	5.65	4.24	3.92	4.10	3.33	3.05	3.23	3.20	1.79	2.49	2.44	1.77	2.98	3.51	20.50	21.75	22.01
Longitudo praeventralis	5.67	6.18	6.87	6.30	4.08	5.08	8.52	3.94	6.04	3.96	4.07	3.98	4.00	3.59	3.53	3.29	2.48	2.53	2.50	2.16	2.41	3.71	20.41	20.53	20.01
Longitudo praeanalis	4.46	6.96	7.04	6.61	4.51	5.58	8.64	3.53	9.53	3.49	3.88	3.71	4.07	4.44	4.35	3.96	1.83	2.63	2.65	1.33	2.43	3.15	26.44	21.78	23.56
Longitudo pedunculi caudae	8.93	9.90	9.56	10.30	5.26	7.08	13.94	6.01	10.10	9.57	8.56	8.94	10.96	11.87	11.62	3.98	10.47	9.86	9.96	8.05	9.34	11.44	21.40	21.55	21.99
Longitudo trunci	5.03	6.76	7.06	4.83	4.84	5.12	8.67	3.35	6.40	3.60	3.12	3.39	4.35	7.63	6.93	6.09	2.39	3.63	3.17	3.02	3.97	4.14	22.16	21.71	22.37
Longitudo capitis lateralis	4.60	4.52	5.03	6.77	4.19	5.05	8.60	3.28	6.77	5.24	4.46	4.84	4.86	4.57	4.54	7.37	3.35	4.70	3.78	2.28	2.08	3.74	19.29	19.43	19.90
Longitudo spatii postorbitalis	6.04	6.24	6.43	8.22	6.02	6.67	11.21	5.88	8.43	5.21	5.10	5.13	5.81	6.38	6.16	7.85	4.00	5.29	4.31	2.77	6.18	7.29	21.16	22.13	22.26
Diameter oculi	5.90	8.54	8.16	5.50	6.77	6.67	7.63	4.41	6.15	6.64	6.93	6.64	6.45	9.42	9.81	9.58	5.50	4.61	5.55	4.09	1.37	2.07	13.92	13.72	14.41
Longitudo spatii praeorbitalis	10.00	12.10	10.11	12.20	7.14	9.04	14.54	5.62	12.81	13.60	7.70	11.03	6.67	5.41	5.65	6.90	7.67	7.47	6.38	3.19	1.48	9.44	23.01	20.51	21.58
Longitudo P	4.92	4.94	4.92	7.78	4.13	5.20	8.86	6.70	7.73	7.40	5.04	6.46	7.20	3.73	5.13	6.30	4.47	4.79	5.33	4.13	8.19	6.98	18.71	18.88	19.05
Longitudo V	6.90	5.33	6.64	6.27	4.68	5.15	8.20	5.17	6.91	7.86	6.29	7.30	6.44	4.67	5.05	2.25	5.82	5.06	5.21	2.11	3.39	6.89	20.61	19.95	20.36
Summa altitudo A	10.61	5.80	8.15	11.12	7.31	7.74	8.83	6.81	7.55	9.41	8.72	9.30	6.23	5.41	5.55	10.42	10.75	10.25	10.03	8.88	7.21	4.06	19.86	19.96	20.23
Summa altitudo D	5.67	5.95	7.09	4.43	8.49	7.61	8.06	5.27	6.60	9.02	7.07	8.07	10.76	10.50	10.51	8.71	11.36	10.46	9.25	2.71	4.59	6.01	19.07	18.91	19.19
Longitudo pinnae C superior	7.49	6.20	7.01	6.22	5.23	6.42	8.05	6.11	7.01	7.61	7.42	7.37	5.04	6.38	5.90	2.53	5.47	5.98	5.57	4.67	5.16	7.68	19.26	19.66	22.27
Longitudo pinnae C inferior	6.45	5.00	6.30	7.41	4.17	5.41	5.50	5.10	6.11	7.47	6.15	6.79	3.06	5.80	5.09	5.27	5.25	5.06	5.07	4.07	5.37	7.74	18.09	18.92	19.18
Longitudo pinnae C media	8.60	7.95	7.93	6.87	7.68	8.42	8.90	6.29	7.72	7.14	12.00	8.40	3.78	10.68	9.40	5.49	8.02	9.26	8.08	9.28	6.22	11.00	25.08	16.71	18.92
Longitudo basis D	8.88	7.19	7.75	5.46	8.00	7.49	11.20	7.34	9.40	6.05	6.33	6.61	3.29	8.38	7.57	5.97	7.22	6.64	6.38	6.03	7.86	5.42	20.41	22.35	22.08
Distantia praedorsalis	4.76	5.91	6.31	8.19	5.99	6.70	6.76	3.83	5.72	4.12	3.90	4.05	2.51	4.26	3.86	4.49	3.44	3.70	6.29	6.64	4.63	4.58	19.99	20.65	20.97
Distantia postdorsalis	6.77	7.95	8.24	6.58	5.58	5.96	9.41	4.50	7.27	7.84	6.61	7.13	3.83	4.56	4.49	4.47	5.58	5.71	5.49	3.99	2.69	5.70	20.84	22.07	22.34
Spatium inter P et V	4.89	6.63	6.49	7.59	4.99	6.72	8.31	4.67	6.86	4.15	4.66	4.74	4.63	6.47	6.34	3.03	3.53	4.62	4.26	4.53	3.80	3.61	21.56	23.23	23.61
Spatium inter V et A	12.43	9.22	10.45	6.52	7.58	7.38	6.26	6.00	7.33	5.18	6.46	7.42	7.56	6.32	7.03	2.87	3.84	3.91	3.96	3.56	4.29	5.97	21.11	23.55	23.90
Longitudo basis A	11.59	8.26	10.00	9.33	8.72	8.80	13.54	8.93	10.92	10.56	8.53	9.48	5.62	9.68	8.72	8.21	13.78	12.48	11.22	8.68	7.02	9.49	24.25	23.99	24.29
Summa altitudo capitis	5.04	6.90	7.11	9.21	5.90	6.84	8.10	3.16	6.44	4.69	4.86	4.82	4.93	7.22	6.80	3.19	4.80	4.50	5.16	4.90	5.34	5.10	22.43	22.08	22.55
Summa altitudo corporis	8.72	7.96	8.82	9.77	5.24	6.73	8.98	3.79	6.85	5.29	6.64	6.67	6.66	6.47	6.39	1.50	4.49	4.22	4.89	4.33	4.74	5.09	23.43	24.59	25.04
Minima altitudo corporis	7.88	6.53	7.18	6.96	6.08	6.23	10.11	6.49	8.40	5.87	5.57	5.62	5.46	4.82	4.93	7.43	7.35	2.48	2.79	2.38	5.61	6.25	21.22	21.43	21.77
Summa latitudo capitis	7.50	6.39	7.94	18.37	8.97	11.73	13.03	8.96	14.14	6.50	14.16	10.50	9.86	8.73	9.19	11.65	11.61	11.30	12.48	9.87	4.25	13.84	26.08	25.49	25.52
Summa latitudo corporis	9.73	8.59	9.24	9.52	7.50	8.02	8.75	4.25	6.61	6.63	7.23	6.82	3.12	9.77	8.60	6.05	6.62	6.18	5.53	4.61	7.15	5.64	25.06	26.68	26.74
Summa longitudo in circuitu	6.80	5.87	7.62	8.72	6.02	6.80	8.54	4.61	6.89	4.41	5.49	5.26	4.17	7.33	6.54	2.53	3.18	3.84	3.76	3.62	5.26	4.82	22.80	23.72	24.04
Pondus	17.99	17.72	20.02	17.83	13.59	15.06	19.82	9.11	7.28	11.90	12.19	13.08	8.04	9.91	10.04	7.33	5.37	6.53	6.93	4.04	9.73	7.36	61.43	58.43	61.21

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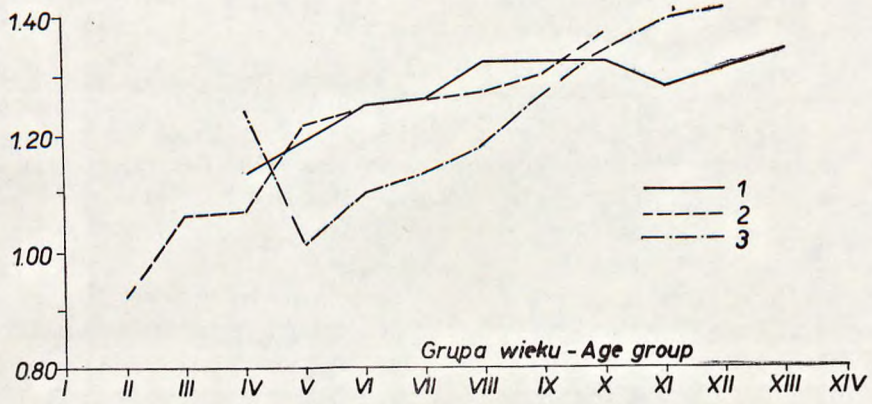
age groups IV to VIII; this is followed subsequently by a certain decrease in its value in the ninth, tenth, and eleventh years; in age groups XII and XIII a slight increase is again observed. In general values of the nutrition coefficient, calculated for individual age groups, are fairly high and similar to the increase in this coefficient for the roach in the



Ryc. 3. Współczynnik odżywiania płoci: 1. Przeczyce, 2. Goczałkowice (Skóra 1964), 3. Kozłowa Góra (Skóra 1964a)

Fig. 3. Nutrition coefficient of the roach: 1. Przeczyce, 2. Goczałkowice (Skóra 1964), 3. Kozłowa Góra (Skóra 1964a)

reservoir in Goczałkowice (Skóra 1964) while being considerably higher than the nutrition coefficient calculated for age groups V—IX of the roach from the dam reservoir in Kozłowa Góra (Skóra 1964a).

The biometric analysis of absolute measurements of 30 plastic features of the roach from the Przeczyce Reservoir showed that in individual age groups females attained higher mean values than did the males. Thus, it follows that not only the body length but the development of other features of the body proceeds in roach females more rapidly than in males (Table II).

Variability of the roach population

It can be seen from Table III that the majority of the examined features show a decrease of relative variability with age, i.e. with growth. This was also the case with roach (Skóra 1964) and tench from the reservoir in Goczałkowice (Skóra 1964a), as well as in other species as, e.g., carp (Włodek 1966), and gudgeon (*Gobio gobio*) (Skóra, Włodek 1969). This refers also to the body weight where a decrease in variability followed by stabilization was observed (Table III). Differences

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in the variability (v%) of body size between males and females of the examined species were rather small. On the average 29 features of the whole material in seven age groups of males and nine age groups of females from the dam reservoir in Przeczyce were identical (v% = 21.26).

The proportions of 23 linear measurements of the body were referred to the body length (*longitudo corporis*) and the proportions of 5 measurements of the head were referred to the lateral length of the head (*longitudo capitis lateralis*). On the basis of these calculations (Table IV) it can be seen that the percentage of certain plastic features of the body as well as of the head and especially the total body length, ventral length of the body, length of the head, length of fins, pre-dorsal length, and eye diameter decrease with age, whereas other features, such as the distance from the pectoral fin to the ventral fin and from the ventral to the anal fin, greatest body height, greatest circumference of the body, post-eye length, height of the head and width of the forehead, increase markedly with age. There are, however, body proportions of the examined species which show stabilization during the whole life course, e.g. anal length, body length, length of the base of the dorsal and anal fin, smallest body height and length of the mouth (Table IV). This refers, of course, to relative and not to absolute stability. Measurements performed by means of a slide caliber with accuracy to ± 1 mm did not permit the registration of smaller differences. A similar phenomenon was previously observed with the roach from the dam reservoir in Goczałkowice (S k ó r a 1964).

The mean proportions of males and females did not show any marked differences. For 23 examined mean proportions of the body only the total body length of males was by 1.2 per cent greater than that of females. The differences between the other 22 features of the body of males and females did not exceed 1.0 per cent, or even no differences at all were observed. This also holds true for plastic features of the head where for 5 considered measurements only the width of the forehead of males was greater by 1.4 per cent than that of females, the other 4 plastic features of the head showing differences below 1.0 per cent. It follows from the above that males from the reservoir in Przeczyce are characterized by a greater length of the tail fin and a greater width of the forehead. As a whole for 23 calculated body proportions of the examined species in 20 cases higher values were obtained for males and in 6 cases for females, the other 2 features being identical in value or independent of sex. Those proportions which proved independent of sex were body length and post-dorsal distance. It follows that there exists a sexual dimorphism in the structure of some details of the body of males and females in this species from the reservoir in Przeczyce. It is, however, not so pronounced as to permit the sex of the examined species to be distinguished visually.

Comparing the magnitude of the calculated body proportions from the

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Tabela IV. Charakterystyka cech plastycznych płoci ze zbiornika zaporowego w Przeczycach

Table IV. Characteristic of plastic features of roach from the dam reservoir in Przeczyce

Grupa wieku Age group	IV			V			VI			VII			VIII			IX			X	XI	XII	XIII	XIV	XV	Razem Total		
Liczba badanych ryb Number of examined fish	12	23	35	11	31	42	13	17	30	13	11	24	5	13	18	4	10	14	17	9	8	7		1	59	146	205
Płeć Sex	♂	♀	♂♀	♂	♀	♂♀	♂	♀	♂♀	♂	♀	♂♀	♂	♀	♂♀	♂	♀	♂♀	♀	♀	♀	♀		♂	♂	♀	♂♀
Longitudo corporis in cm	13,9	15,0	14,6	16,3	17,0	16,8	19,8	20,8	20,2	22,0	22,4	22,2	23,4	23,9	23,8	25,1	25.8	25.6	26.1	26,9	27,6	28,0		29,5	19,3	21,5	20,9
in % longitudo corporis																											
Longitudo totalis	122,7	122,7	122,7	121,9	122,3	122,2	122,2	121,8	122,0	121,7	121,3	121,5	122,1	120,9	121,3	120,9	119,2	119,7	119,5	119,3	119,0	120,5		118,3	121,9	120,7	121,0
Longitudo praeventralis	49,2	49,3	49,3	48,7	49,2	49,1	49,5	50,0	49,8	49,1	48,9	49,0	48,8	48,7	48,7	49,4	48,2	48,5	48,0	47,5	47,8	47,6		46,1	49,0	48,6	48,8
Longitudo praeanalis	70,6	70,5	70,5	70,2	71,7	71,3	72,2	72,5	72,2	71,5	71,5	71,5	70,4	70,5	70,4	71,8	71,2	71,4	71,1	71,5	71,3	71,2		66,1	71,1	71,3	71,2
Longitudo pedunculi caudae	20,8	20,2	20,4	20,1	20,4	20,4	19,8	20,0	19,9	20,1	19,8	20,0	19,5	20,1	19,9	19,3	19,8	19,7	19,5	19,6	19,2	18,4		21,7	20,0	19,8	19,9
Longitudo trunci	80,0	80,0	80,0	80,1	80,6	80,5	80,2	80,7	80,5	80,3	80,0	80,1	79,4	80,0	79,8	80,1	79,5	79,6	79,7	79,9	80,1	80,1		80,7	80,1	80,1	80,1
Longitudo capitis lateralis	22,5	22,0	22,2	22,2	22,1	22,2	21,2	21,9	21,6	21,6	21,6	21,6	22,4	21,7	21,8	20,9	21,2	21,1	20,9	20,7	20,5	20,6		21,4	21,7	21,4	21,5
Longitudo P	18,6	17,7	18,0	18,2	17,6	17,7	16,9	16,9	16,9	17,3	16,5	16,9	18,1	16,9	17,2	17,1	16,5	16,7	16,3	16,1	16,0	16,0		15,9	17,6	16,8	16,9
Longitudo V	18,1	17,3	17,6	17,8	17,5	17,6	17,1	17,3	17,2	17,7	16,8	17,3	17,9	17,4	17,5	17,7	16,8	17,0	16,5	16,3	16,1	16,5		17,6	17,7	16,9	17,1
Summa altitudo A	15,4	15,1	15,2	14,7	14,1	14,3	14,2	13,5	13,8	14,6	13,6	14,1	14,5	13,9	14,1	14,1	13,5	13,7	13,2	13,3	14,0	13,3		13,6	14,6	13,8	14,0
Summa altitudo D	22,6	22,9	22,8	21,8	20,7	21,0	20,0	19,8	19,9	20,4	19,7	20,1	21,5	19,9	20,3	21,3	19,9	20,3	19,5	18,9	19,5	19,2		19,7	21,0	20,1	20,4
Longitudo pinnae C superior	24,1	23,7	23,8	22,0	23,0	22,7	22,4	22,2	22,3	22,6	22,3	22,4	22,9	22,3	22,5	21,9	21,6	21,7	21,6	21,5	21,9	21,9		20,0	22,6	22,3	22,4
Longitudo pinnae C inferior	24,5	24,4	24,5	23,2	23,3	23,3	22,7	22,6	22,6	22,5	22,5	22,5	23,4	22,7	22,9	22,4	21,9	22,0	21,8	21,5	21,8	22,2		19,7	23,0	22,6	22,7
Longitudo pinnae C media	10,3	9,7	9,9	9,3	9,9	9,7	9,0	9,1	9,0	8,9	9,1	9,0	9,5	8,8	9,0	9,4	8,0	8,4	8,2	8,0	8,2	8,3		7,5	9,2	8,8	8,9
Longitudo basis D	14,8	14,4	14,6	15,4	14,4	14,7	14,6	14,8	14,7	14,8	14,9	14,9	14,8	13,7	14,0	14,8	14,5	14,6	14,5	14,1	14,4	14,7		13,9	14,8	14,4	14,5
Distantia praedorsalis	51,9	51,5	51,6	52,3	52,4	52,4	51,2	51,9	51,6	51,4	51,6	51,5	51,9	51,7	51,8	51,5	51,0	51,1	50,5	49,2	49,6	50,8		49,2	51,6	51,1	51,2
Distantia postdorsalis	38,2	37,9	38,0	38,3	38,3	38,3	37,9	38,4	38,2	38,1	37,5	37,8	38,2	38,4	38,3	37,0	38,0	37,7	38,4	38,7	37,5	37,3		39,3	38,1	38,1	38,1
Spatium inter P et V	26,6	26,6	26,6	25,5	26,7	26,4	27,4	27,7	27,6	26,9	27,5	27,2	27,0	27,7	27,5	26,3	27,4	27,1	27,6	27,9	27,5	27,3		26,8	26,7	27,3	27,2
Spatium inter V et A	24,3	24,1	24,2	24,9	25,4	25,3	25,0	25,8	25,5	24,1	25,9	24,9	24,6	25,5	25,3	25,3	25,8	25,7	25,8	25,6	25,5	25,8		24,4	24,6	25,5	25,3
Longitudo basis A	11,3	11,5	11,4	12,1	11,6	11,7	12,2	11,8	12,0	12,2	12,1	12,2	12,5	11,7	11,9	12,2	11,6	11,8	11,6	11,7	11,6	11,9		12,2	12,1	11,7	11,8
Summa altitudo corporis	31,3	31,5	31,4	32,4	32,6	32,5	33,3	33,9	33,6	32,6	34,2	33,3	35,0	34,9	34,9	33,8	34,1	34,0	34,4	34,2	34,0	34,2		35,6	33,0	33,6	33,5
Minima altitudo corporis	9,8	9,6	9,7	10,0	9,8	9,8	9,8	10,0	9,9	9,9	9,8	9,8	10,2	9,8	9,9	9,8	9,6	9,7	9,6	9,5	9,5	9,6		9,8	9,9	9,7	9,7
Summa latitudo corporis	13,3	13,2	13,3	14,1	13,9	14,0	15,1	14,9	15,0	15,2	14,8	15,0	15,1	15,3	15,2	15,6	15,2	15,3	15,2	15,1	15,0	15,5		15,6	14,8	14,7	14,7
Summa longitudo in circuitu	77,8	77,1	77,3	79,8	79,3	79,4	81,9	83,1	82,6	80,9	82,8	81,8	84,1	83,7	83,8	81,3	82,0	81,8	82,2	80,8	80,7	82,5		87,1	81,0	81,2	81,2
Longitudo capitis lateralis in cm	3,1	3,3	3,2	3,6	3,8	3,7	4,2	4,5	4,4	4,7	4,8	4,8	5,2	5,2	5,2	5,2	5,5	5,4	5,5	5,6	5,6	5,8		6,3	4,2	4,6	4,5
in % longitudo capitis lateralis																											
Longitudo spatii postorbitalis	47,6	47,5	47,5	48,6	48,5	48,5	49,3	48,9	49,1	50,0	49,4	49,7	50,4	49,7	49,9	50,5	50,4	50,4	50,2	50,6	50,6	52,2		47,6	49,3	49,5	49,5
Diameter oculi	26,6	26,9	26,8	26,1	25,7	25,8	25,3	24,7	24,9	23,8	23,3	23,6	21,3	23,4	22,9	22,9	22,0	22,2	21,9	22,0	21,8	22,5		22,2	24,5	23,7	24,0
Longitudo spatii praeorbitalis	27,9	27,2	27,4	27,3	28,2	28,0	27,8	28,5	28,2	28,6	28,0	28,3	29,1	28,6	28,8	27,6	27,5	27,5	27,9	28,2	27,4	27,7		30,2	28,1	27,9	28,0
Summa altitudo capitis	76,1	77,4	77,0	78,7	78,1	78,2	82,6	82,1	82,3	81,2	81,8	81,5	83,3	79,2	80,4	86,7	80,6	82,3	82,3	83,0	84,3	83,9		85,7	81,1	80,8	80,9
Latitudo frontis	35,6	37,1	36,6	40,4	38,8	39,2	44,9	40,3	42,2	42,7	41,7	42,3	43,0	40,2	41,0	45,2	41,0	42,2	42,7	41,2	41,5	43,1		39,7	41,9	40,5	40,9

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dam reservoir in Przeczyce with the corresponding body proportions calculated by Žukov (1965) for the roach from the river Dnieper basin or from the Niemen of the Dźwina basin no important differences were observed. This also holds true for body proportions of the roach from the reservoir in Goczałkowice (Skóra 1964) and Kozłowa Góra (Skóra 1964a). It thus results that in each case the same species of roach, i.e. the nominal form *Rutilus rutilus* L., was considered.

Meristic features of roach

The pharyngeal teeth of the roach occur in one row in as many as eight different arrangements (Table V). Hence it follows that no great differences in arrangement of pharyngeal teeth depending on sex are visible. Variability of teeth arrangements in the roach from the reservoir in Przeczyce is fairly considerable in comparison with only three arrangements (6—5, 5—5, 6—6) occurring in the roach from the reservoirs in Goczałkowice (Skóra 1964) and Kozłowa Góra (Skóra 1964a) as well as in those from some other lakes in Poland discussed by Stangenberg (1938). Žukov (1965), who examined this feature in the roach from some rivers in White Russia, also observed only three arrangements of pharyngeal teeth.

The number of scales in the lateral line depends on the geographical situation of the reservoir, river, or lake (Pravdin 1928) and on environmental conditions (Stangenberg 1938). Stangenberg (1938) examined this feature, among others, in the roach from 10 lakes situated in various regions of Poland and suggested that forms with

Tabela V. Układ zębów gardłowych płoci ze zbiornika zaporowego w Przeczycach

Table V. System of pharyngeal teeth of roach from the dam reservoir in Przeczyce

Układ zębów gardłowych System of pharyngeal teeth	♂		♀		♂♀	
	n	%	n	%	n	%
5 - 6	7	15.56	18	15.38	25	15.43
6 - 5	10	22.22	32	27.35	42	25.93
5 - 5	11	24.44	34	29.06	45	27.78
6 - 6	8	17.78	17	14.53	25	15.43
5 - 4	4	8.89	7	5.98	11	6.79
4 - 5	3	6.67	6	5.13	9	5.56
4 - 6	1	2.22	1	0.86	2	1.23
6 - 4	1	2.22	2	1.71	3	1.85
Razem - Total	45	100.00	117	100.00	162	100.00

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a greater number of scales in the lateral line occur more frequently in lakes having poor growth conditions for roach than in normal lakes with favourable growth conditions where this number is smaller. This suggestion is, in a certain sense, corroborated by the present investigations concerning this feature (Table V) in the roach from the reservoir in Przeczyce. The roach from this reservoir have fairly low mean number of scales on the lateral line of the body (43, 45), as well as a rather low upper limit amounting to 46 scales.

The number of rows of scales over the lateral line of the investigated species varied from 7—9 rows and below the lateral line from 3—5 rows.

In the dorsal fin of the examined roach 3 straight, hard rays and 9 to 12 soft branched rays (Table VI) were found, specimens with 11 soft rays

Tabela VI. Cechy merystyczne płoci ze zbiornika zaporowego w Przeczycach

Table VI. Meristic features of roach from the dam reservoir in Przeczyce

Cechy Features	n	Zakresy Range	$\bar{x}$ $\pm m$	σ	v%
Squamae, linea lateralis	166	41 - 46	43.45 ± 0.078	1.003	2.31
Squamae, supra lineam transversalem	166	7 - 9	8.33 ± 0.039	0.506	6.07
Squamae, infra lineam transversalem	166	3 - 5	4.11 ± 0.027	0.348	8.47
Numerus radiorum pinnae D	166	III/ 9 - 12	10.87 ± 0.038	0.485	4.46
Numerus radiorum pinnae P	166	13 - 17	15.48 ± 0.065	0.841	5.43
Numerus radiorum pinnae V	166	8 - 10	8.93 ± 0.027	0.344	3.85
Numerus radiorum pinnae A	166	III/10 - 13	11.56 ± 0.044	0.564	4.88
Numerus radiorum pinnae C	166	17 - 20	19.02 ± 0.029	0.372	1.96
Numerus spinarum branchialium	155	10 - 14	12.06 ± 0.086	1.064	8.82
Numerus vertebrarum	144	37 - 43	40.33 ± 0.088	1.061	2.63

being predominant. It is worth noting that the last ray both in the dorsal and anal fin, though sometimes divided right to the base, is always considered as one. The range of variations of soft rays in the dorsal fin of the examined species was, thus, by one ray greater than was the case with the roach from Goczałkowice (Skóra 1964) and Kozłowa Góra (Skóra 1964a) where 9—11 soft branched rays were found. Stangenberg (1938) as well as Žukov (1965) report 8—11 soft rays in the dorsal fin of the species *Rutilus rutilus* L. Synek (1967), on the other hand, gives for the dorsal fin of the investigated roach 2 and for the most part 3 hard, straight rays and 7—11 soft rays with a marked predominance of 10 soft rays, and not 11 as in our case. Hence, it follows that this feature of the roach also shows a certain variability depending on the reservoir from which the fish derives.

It results form Table VI that 13 to 17 rays occur in the pectoral fin of the roach from the dam reservoir in Przeczyce and 8 to 10 rays in the

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ventral fin, whereas in the anal fin 3 hard rays and 10 to 13 soft branched rays were found. The range of variation for the roach from Przeczyce is shifted by 1 soft ray upwards in relation to that (9 to 12 rays) of the number of soft rays in the anal fin of the roach caught in the reservoirs in Goczałkowice (Skóra 1964) and in Kozłowa Góra (Skóra 1964a). Stangenberg (1938), similarly to Žukov (1965), reports a slightly greater range of variation in the number of soft rays in the anal fin of the roach, i.e. 8 to 12, whereas, Synek (1967) stated that 2 or most frequently 3 hard rays and 9 to 13 soft branched ones occur in this fin of the roach appearing in the waters of Czechoslovakia.

The number of gill-rakers given in Table VI, counted always on the left side of the head outside the edge of the first bronchial arch, varied from 10 to 14 gills. Sometimes an inequality in the number of gill-rakers was observed on the left and right side of the head. This irregularity usually amounted to 1 or 2 gills, sometimes 3, and sporadically 4 gills more on the left or right bronchial arch. The number of vertebrae in the spinal column of the roach from the reservoir in Przeczyce (Table VI) showed a slightly greater range of variation than that recorded for the reservoirs in Goczałkowice (Skóra 1964) and Kozłowa Góra (Skóra 1964a).

It results from Table VI that the meristic features of the investigated roach are distinguished by a low variability, since the highest variability coefficient (v%) characteristic of the number of gill-rakers on the external edge of the first bronchial arch amounted to 8.82 per cent.

The meristic features, especially those of low variability as, e.g., in the investigated roach, are very good diagnostic characteristics in determining the species.

Fertility of female roach

The roach in the dam reservoir in Przeczyce reach sexual maturity by the fourth year of age; all the examined species in age group IV were sexually mature and fit for spawning. In the years 1955—1966 spawning took place from the third decade of April till the first decade of June inclusive, depending on the atmospheric conditions and water temperature. Towards the end of April and in May partly spawned female roach were encountered, whereas, all females from the catch on 16th June were already fully spawned; this would support the suggestion that roach females do not spawn once during the season but that their spawning has a staggered character, similar to that of other fish species, e.g. tench.

The results of investigations on roach fertility are plotted in Table VII. Variations in fertility between individuals are fairly great, ranging from 12480 to 334464 eggs for one female. Calculated mean values permit

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Tabela VII. Zależność płodności płoci od jej długości i ciężaru ciała

Table VII. Dependence of roach fertility on length and weight of body

Klasa długości w cm Length class in cm	Średni ciężar ryby w g Mean weight of fish in g	Ciężar gonad w IV-V stadium rozwoju Weight of gonads of IV-V stage				Liczba ziarn ikry w jajnikach Number of eggs in the ovary		Liczba badanych ryb Number of fish
		w g - in g		w % - in %				
		od - do extreme values	średnio mean	od - do extreme values	średnio mean	od - do extreme values	średnio mean	
12.0-14.0	60.5	5- 11	8.0	8.49-16.18	12.33	12480- 27456	19968	2
14.0-16.0	78.2	7- 13	9.8	7.97-16.88	12.37	17472- 32448	24461	5
16.0-18.0	106.5	11- 18	15.5	10.38-16.35	14.54	27456- 44928	38688	4
18.0-20.0	161.2	13- 35	23.0	7.50-20.96	13.70	32448- 87360	57408	4
20.0-22.0	219.6	18- 65	39.8	9.04-27.66	17.09	44928-162240	99158	10
22.0-24.0	266.8	23- 87	48.7	9.04-28.88	17.60	57408-217152	121545	11
24.0-26.0	345.0	38- 85	49.5	10.68-21.52	13.42	94848-212160	123552	6
26.0-28.0	494.2	76-134	105.0	18.14-24.77	21.02	189696-334464	262080	4

Tabela VIII. Ciężar gonad samic płoci w różnych okresach dojrzałości płciowej w % ciężaru ciała

Table VIII Weight of gonades of female roach in various periods of sexual maturity in percentage of body weight

Data odłowu Date of catch	20.IV	20.V	16.VI	15.VII	23.VIII	10.IX	7.X
Liczba badanych ryb Number of examined fish	20	27	5	18	24	15	6
Zakres wahań Range	7.79-21.52	7.50-28.88	1.02- 1.82	0.78- 2.49	2.54- 8.54	2.78-10.90	7.88-10.30
Średnio % Mean %	15.82	16.20	1.22	1.39	5.25	7 14	9.21

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a certain dependence between the body length and body weight of a fish and its fertility to be established (Table VII). This relation was also established for the roach from the reservoirs in Goczałkowice (Skóra 1964) and Kozłowa Góra (Skóra 1964a). In some individual cases larger females had a smaller gonad mass and a smaller number of eggs than females smaller in size. There were also females with a small mass of gonads with respect to the given class of length and with a small number of eggs. Absolute fertility of the roach from the reservoir in Przeczyce must be considered as fair, better than the absolute fertility of the roach from the reservoir in Kozłowa Góra (Skóra 1964a) but slightly lower than that of the roach from the reservoir in Goczałkowice (Skóra 1964).

The mean absolute fertility of the roach from various waters in White Russia (Žukov 1965) was, for individual classes of body length, considerably lower than that of the discussed roach. According to Čaban (1959), the fertility of the roach living in Siberia is on the average 29196 eggs.

The ratio of egg number of one female to one body weight unit (1 kg) is called relative fertility and ranged in the examined roach from 330000 to 530311 eggs, depending on the body weight (Table VII).

The coefficient of sexual maturity (ratio of the gonad weight and body weight expressed in percentage) was highest in April and May in the IV and V stage of sexual maturity (Table VIII). For the roach from the reservoir in Przeczyce the mean coefficient (16.20 per cent) was in May similar to that for the mature roach caught in Kozłowa Góra (Skóra 1964a) in the same month but much lower than that calculated for the roach from Goczałkowice (23.97 per cent).

The size of eggs of the examined roach varied from 0.99 to 1 1.42 mm (1.16 mm on the average), i.e. the eggs of the roach from the reservoir in Przeczyce were slightly larger than those from the reservoir in Goczałkowice (Skóra 1964) where the average size of eggs ranged from 0.67 to 1.19 mm (0.85 mm on the average) (Skóra 1964). Žukov (1965) reports that the eggs of the roach from White Russia varied from 1.0 to 1.5 mm in diameter.

Nutrition of roach

Not in all specimens of roach could the content of the alimentary canal be clearly defined; sometimes the alimentary canal was only partly filled, in other cases the content was considerably digested and thus difficult to define precisely. No difference in the content of the alimentary canal of females and males was observed.

Two periods — some months long — were considered: the first from April to July and the second August, September, October. A great number

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of specimens were examined in order to reduce the possibility of chance. Neither qualitative nor quantitative differences in such long periods of time are of any importance. The kind of nutrition depends, to a great extent, on the size of the fish (W e s t p h a l e n 1956). The whole material in this paper is elaborated as a whole without classification into size classes as in our case only fish of larger size are considered.

To define the composition of the content of the alimentary canal of the roach from the dam reservoir in Przeczyce the material was divided into 5 basic groups in the same way as W e s t p h a l e n (1956) did when examining the nutrition of roach from several German lakes. These are: crustaceans, insects, molluscs, plants and detritus.

1. **Crustaceans:** *Bosmina longirostris, Daphnia longispina, D. cuculata, D. pulex. D. magna, Pleuroxus* sp., and *P. uncinatus* consituted the main contents, while *Chydoridae, Copepoda, Ostracoda, Cyclopidae, Gammaridae* (*pulex*), and fragments of *Asellus* sp. occurred in small quantities or even in single fragments.

2. **Insects:** air and water insects were found in this group. *Tendipedidae* (*Tendipes plumosus, Tanypodinae, Orthocladiinae*) being of the greatest importance. A considerable part in the food of the roach was played by *Odonata* and *Coleoptera*, while *Plecoptera* and *Neuroptera* as well as *Notonecta* sp., and water mites (*Hydrachnella, Hydracarina*) were encountered rarely or even incidentally. In some alimentary canals remnants of chitine, wings, and legs were encountered in the well-digested content but these were hard to identify precisely.

3. **Molluscs** — while *Valvata piscinalis, Bythinia tentaculata, Pisidium* sp., occurred in fairly great quantities, *Gyraulus albus, Viviparus* sp., were only sporadic. Idendification of *Mollusca* whose shells were well preserved was not difficult.

4. **Lower and higher plants** — all algae (*Aphanizomenon* sp., *Gomphosphaeria* sp. *Merismopedia* sp., *Phacus* sp., *Trachelomonas* sp., *Dinobryon* sp., *Cladophora* sp., *Cosmarium* sp., *Oedogonium* sp., *Zygnema* sp., *Spirogyra* sp., *Pediastrum* sp., *Ulothrix* sp., *Mougeotia* sp., *Scenedesmus* sp., *Closterium* sp., *Volvox* sp., *Staurastrum* sp., *Chara* sp., *Anabaena* sp.) are considered lower plants, while fragments of *Potamogeton* sp., *Myriophyllum* sp., *Ceratophyllum* sp. and *Elodea canadensis* are classed as higher ones.

5. **Undetermined remnants** — in the main content, pulped plant remains (detritus) occur in the food mass of the roach sometimes in small but sometimes in quite large quantities. This material was probably taken from the bottom of the reservoir during feeding.

The share of individual nutrition groups in the total food was expressed in terms of percentage in relation to the total weight of the food mass. The quantitative comparison of the food of the roach from the dam reservoir in Przeczyce was, on the whole, similar to that of the roach

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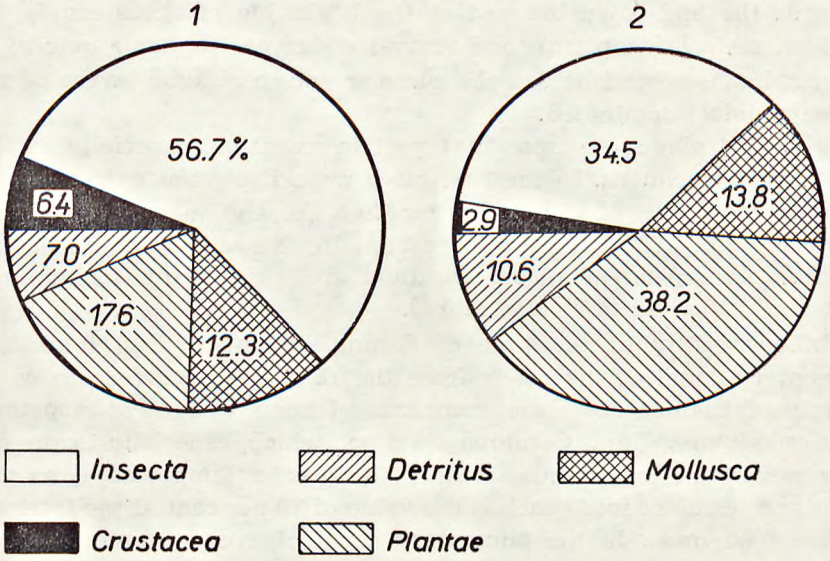
from the dam reservoirs in Goczałkowice (Skóra 1964) and Kozłowa Góra (Skóra 1964a) and to that of larger specimens of roach examined by Westphalen (1956) from the Lake Selenter. From April to July inclusive (fig. 4) the fish preferred food of animal origin, whereas, from



Ryc. 4. Procentowy udział poszczególnych składników pokarmowych w analizowanych przewodach pokarmowych płoci w dwóch okresach roku: 1. kwiecień, maj, czerwiec, lipiec (IV, V, VI, VII), 2. sierpień, wrzesień, październik (VIII, IX, X)

Fig. 4. Percentage of individual food components in the analysed alimentary canal of the roach in two periods of the year: 1. April, May, June, July (IV, V, VI, VII), 2. August, September, October (VIII, IX, X)

August to October plant food dominated. *Crustacea* did not play any important part in the analysed food of the roach, especially in the second investigated period. The largest quantities of *Crustacea* were found in the food mass of the roach caught in the spring months, especially in smaller specimens with a body length under 20 cm. The smaller the roach the more crustaceans were found in the content of its alimentary canal. Thus, in some cases this group of food constituted as much as 35 per cent of weight of the food mass. With regard to the occurrence of *Crustacea* in the alimentary canal of the roach, the present observations corroborate, in general outlines, those made by Westphalen (1956). He examined, among other features, the food composition of the roach from three German lakes and found a considerably greater amount of crustacea in the alimentary canals of smaller size groups than in the canals of bigger specimens.

Insects — especially in the first examined period (from April to July inclusive) — were the basic food components of the roach from the

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reservoir in Przeczyce; with some specimens, especially larger ones, it even exceeded 67 per cent of the food mass.

The number of individual representatives of insects eaten by a given roach changed, however, depending on the time the food was taken. While towards the end of spring and at the beginning of the summer mainly case-worms (*Trichoptera*) and may-fly larvae (*Ephemeroptera*) were caught, in the second half of the summer and in autumn larvae of midges (*Tendipedidae*) dominated.

Mollusca played an important part in nutrition, especially in that of the largest specimens. In the first place were *Bythynia tentaculata* L. and *Valvata piscinalis* Müll., and *Pisidium* sp. and in smaller quantities: *Gyraulus albus* Müll., *Viviparus* sp. In the alimentary canal of the smallest specimens of roach, *Pisidium* sp. was mainly found and less frequently *Valvata piscinalis* Müll.

Independently of the time of fishing, the plant food found in the alimentary canal of the roach from the reservoir in Przeczyce consisted mainly of filamentous algae, remnants of pond weed (*Potamogeton* sp.), *Myriophyllum* sp., and *Ceratophyllum* sp., which, especially in the middle of summer and in autumn, was of the greatest importance, so that in some species plant food reached the value of 70 per cent of the total weight of the food mass. In the alimentary canal of every examined specimen small epiphyte diatoms taken together with plant food were found, these being caught by chance and of no great importance. Fragments of leaves of higher plants or their young shoots were also found in the alimentary canal of the roach, especially of older ones.

In the majority of the examined fish grains of gravel or even fine stones were encountered in their alimentary canals. These were most probably introduced into the alimentary canal during the catching of insect larvae from the bottom of the reservoir.

Analysis of the food taken by the roach in the dam reservoir in Przeczyce confirmed the conclusions of previous investigations, carried out among others by Järnefeldt (1921), Neuhaus (1936), Jelinkowski (1950), Pliszka (1953, 1956), Stangenberg (1958), Westphalen (1956), Paschalski (1958), and Skóra (1964, 1964a), that the roach is not only phytophagous, as was suggested by, e. g., Šusta (1905) and Levander (1909), but is mainly a carnivorous animal feeding on insects, *Mollusca* and *Crustacea*. This variety in food composition of the roach shows its good adaptation to the conditions of the biotopus. The kind of food taken by fish throughout the year depends to a great extent on the current availability and behaviour of nutritive organisms, the chemico-physical conditions and the hydrographic environment.

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STRESZCZENIE

Praca została wykonana w ramach zespołowych badań nad metodyką zagospodarowania przeczyckiego zbiornika zaporowego, prowadzonych przez Zakład Biologii Wód PAN w Krakowie.

Płoć jest jednym z najpospolitszych gatunków ryb zasiedlających zbiornik przeczycki, dzięki czemu stanowi istotny składnik zespołu ichtiofauny zbiornika. Badania oparto na 205 okazach płoci złowionej w zbiorniku przeczyckim za pomocą sieci biernego połowu (tabela I). Pozyskano okazy w wieku od 4 do 15 lat o długości ciała 12,6 do 29,5 cm. Opracowano wiek, wzrost, cechy morfologiczne, merystyczne, płodność i zawartość przewodów pokarmowych płoci w zbiorniku.

W analizowanej populacji płoci zdecydowaną przewagę miały samice, a ich udział wynosił aż 71,2%. Stosunek ten niewiele się zmienia w zależności od okresu połowu, zmienia się jednak w obrębie poszczególnych grup wiekowych. Stwierdzono również nierówny wzrost samic i samców płoci, a różnica ta w długości ciała wahała się od 1,8 do 7,3% na korzyść samic.

Wzrost płoci w zbiorniku przeczyckim w porównaniu do wzrostu płoci w innych akwenach leżących na terenie całej Europy jest bardzo dobry (ryc. 1, 2), co wskazuje na korzystne dla tej ryby warunki środowiskowe w omawianym zbiorniku.

Wartości współczynnika odżywienia (ryc. 3) kształtowały się niejednakowo w poszczególnych latach, ogólnie jednak jego wartości obliczone dla poszczególnych grup wiekowych płoci były dość wysokie w porównaniu do wartości tego współczynnika u płoci pochodzącej z innych zbiorników wodnych.

Z tabeli II wynika, że nie tylko długość ciała, ale i rozwój większości innych mierzonych cech ciała samic płoci postępuje szybciej niż samców. Prawie wszystkie cechy morfologiczne zmniejszały swoją zmienność z wiekiem ryb, co świadczyłoby o wzroście stabilności kształtu ciała płoci z wiekiem (tabela III). Na podstawie tabeli IV można wykazać, że niektóre cechy plastyczne tak tułowia, jak i głowy zmniejszają się z wiekiem, natomiast inne z wiekiem wyraźnie wzrastają. Są też proporcje ciała badanej płoci, które w okresie całego życia zachowują się stabilnie, oczywiście chodzi tu o stabilność względną.

Zęby gardłowe u płoci ze zbiornika przeczyckiego ułożone jednoszeregowo występowały w ośmiu układach (tabela V). Liczba łusek na linii bocznej płoci wykazywała dość duży zakres wahań od 41 do 46 łusek, przy 7—9 rzędach nad linią boczną i 3—5 rzędach łusek poniżej linii bocznej (tabela VI). W płetwach występowała następująca liczba promieni twardych i miękkich: w grzbietowej III/9—12, w piersiowych 13—17, w brzusznych 8—10, w odbytowej III/10—13 i ogonowej 17—20. Liczba wyrostków filtracyjnych na zewnętrznej krawędzi pierwszego łuku skrzelowego wahała się od 10 do 14 wyrostków. W kręgosłupie płoci z Przeczyc najczęściej spotykało się 40 i 41 kręgów przy rozpiętości wahań od 37 do 43 kręgów.

Wahania osobnicze płodności samic płoci w zbiorniku przeczyckim były bardzo wysokie od 12 480 do 334 464 ziarn ikry od jednej samicy. Na podstawie obliczonych wartości średnich stwierdzono zależność pomiędzy długością i ciężarem ciała ryby a jej płodnością (tabela VII). Współczynnik dojrzałości płciowej (procentowy stosunek ciężaru gonad do ciężaru ciała) najwyższą wartość osiągnął w kwietniu i maju w IV i V stadium dojrzałości płciowej (tabela VIII).

Płoć w zbiorniku przeczyckim od kwietnia do lipca włącznie przedkładała pokarm zwierzęcy nad pokarm pochodzenia roślinnego, natomiast od sierpnia do października zawartość pokarmu roślinnego w przewodach wyraźnie się zwiększyła (ryc. 4). Zawartość przewodów pokarmowych płoci była bardzo różnorodna, co świadczy o bardzo dobrym przystosowaniu się tej ryby do warunków biotopu. Pobieranie

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pokarmu przez ryby w okresie całego roku zależne było w dużej mierze od aktualnej podaży i zachowania się organizmów pokarmowych oraz warunków chemiczno-fizycznych i hydrochemicznych środowiska.

REFERENCES

Balon E., 1955, Růst Plotice (*Rutilus rutilus* L.), Bratislava, Vyd. Slovensk. Akad. Vied.

Čaban A. P., 1959. K biologii nekotorych vidov sornych i malocennych ryb Ust-Kamenogorskogo Vodochranilišča. Sb. rabot po ichtiol. i gidrobiol., Akad. Nauk Kazachsk. SSR. 2, 245—255.

Cabejšek M., S. Frank, 1968. A contribution to the growth of roach (*Rutilus rutilus* Linnaeus) in some waters of Czechoslovakia. Věstnik Českoslov. Spol. Zool., 32, 1, 22—33.

Dyszewska L., F. Markiewicz, 1957, Występowanie ryb w zbiorniku zaporowym w Kozłowej Górze w roku 1953 oraz tempo wzrostu niektórych gatunków. Biul. Zakł. Biol. Stawów PAN, 5, 53—70.

Geyer F., 1938, Alter und Wachstum der wichtigsten Cypriniden ostholsteinischer Seen. Arch. Hydrobiol. 34, 543—644.

Holčik J., 1967, Life history of the roach — *Rutilus rutilus* (Linnaeus, 1758) in the Kličava Valley Reservoir. Věstnik, Českoslov. Spol. Zool., 31, 3, 213—229.

Järnefeldt H., 1921. Fische und ihre Nahrung im Tuusulassee. Acta Soc. Fauna et Flora Fennica. 52, 1, 90—99.

Jelinkowski B., 1950. Pokarm płoci jeziora Charzykowo. Jezioro Charzykowo cz. I., Bad. Leśn., Prace badawcze. Warszawa, PWRZ, 185—215.

Karpińska-Waluś B., 1961. Wzrost płoci (*Rutilus rutilus* L.) w jeziorach okolic Węgorzewa. Roczn. Nauk Roln., 77-B., 329—398.

Kempe O., 1962. The growth of the roach (*Leuciscus rutilus* L.) in some Swedish lakes. Rep. Inst. Freshw. Res. Drottningholm, 44, 42—104.

Klimczyk-Janikowska M., 1970. Wzdręga (*Scardinus erythrophthalmus* L.) ze zbiorników zaporowych w Przeczycach i Chechle — Die Rotfeder (*Scardinus erythrophthalmus* L.) aus den Staubecken Przeczyce und Chechło. Acta Hydrobiol., 12, 263—284.

Levander K., 1909. Beobachtungen über die Nahrung der Parasiten der Fische des Finnischen Meerbusens. Finnland Hydrobiol. Unt.

Neuhaus E., 1936. Studien über das Stettiner Haff und seine Nebengewässer, Untersuchungen über die Plötze. Ztschr. Fisch., 34, 63—111.

Norquist H., 1928. Försök vörande växthastighet och arkstningsförmaga hos tva olika sutareraser. Lund. Södra Sveriges Fiskeriförening.

Paschalski J., 1958. Żywienie się płoci (*Rutilus rutilus* L.) oraz świnki (*Chondrostoma nasus* L.) w Rożnowskim zbiorniku zaporowym. Pol. Arch. Hydrobiol., 5 (18), 55—64.

Pliszka F., 1953. Dynamika stosunków pokarmowych ryb jeziora Harsz. Pol. Arch. Hydrobiol., 1 (14), 271—300.

Pliszka F., 1956. Znaczenie organizmów wodnych jako pokarmu ryb w świetle badań polskich. Pol. Arch. Hydrobiol. 3 (16), 429—458.

Prawdin I. F., 1928. Płoć z jeziora Perty w Suwalszczyźnie. Arch. Hydrobiol. i Rybactwa, 3.

http://rcin.org.pl

Romański J., 1963. Płoć (*Rutilus rutilus* L.) Zalewu Wiślanego na tle badań z lat 1957—1959, Prace MIR, 12, A, 143—164.

Shafi M., P.S. Maitland, 1971. The age and growth of perch (*Perca fluviatilis* L.) in two Scottish lochs. J. Fish. Biol., 3, 1, 39—57.

Skóra S., 1961. Karaś pospolity (*Carassius carassius* L.) z gospodarstwa w Gołyszu — Karausche (*Carassius carassius* L.) aus der Teichwirt. schaft Gołysz. Acta Hydrobiol. 3, 91—112.

Skóra S., 1964. Charakterystyka płoci (*Rutilus rutilus* L.) ze Zbiornika Goczałkowickiego — The characteristics of the roach (*Rutilus rutilus* L.) living in the Goczałkowice Reservoir, Acta Hydrobiol., 6, 351—374.

Skóra S., 1964a. Charakterystyka płoci (*Rutilus rutilus* L.) ze zbiornika w Kozłowej Górze — Characteristics of the roach (*Rutilus rutilus* L.) in the reservoir of Kozłowa Góra. Acta Hydrobiol., 3, 269—284.

Skóra S., 1964b. Charakterystyka lina (*Tinca tinca* L.) ze Zbiornika Goczałkowickiego — Characteristic of the tench (*Tinca tinca* L.) in the reservoir of Goczałkowice. Acta Hydrobiol., 6, 97—118.

Skóra S., 1969. Leszcz (*Abramis brama* L.) w Zbiorniku Goczałkowickim — Der Brassen (*Abramis brama* L.) aus dem Staubecken von Goczałkowice. Acta Hydrobiol., 11, 377—406.

Skóra S., J. M. Włodek 1969. The gudgeon (*Gobio gobio* L.) from the Dunajec river basin. Věstnik Českolov. Spol. Zool., 33, 351—368.

Skóra S., 1970. Wzrost płoci, leszcza i lina w zbiorniku zaporowym Goczałkowice. Materiały WPWK Katowice.

Stangenberg M., 1938. Zmienność ekologiczna płoci. Rozpr. i sprawozd. Inst. Bad. Lasów Państw. A, 19.

Stangenberg M., 1950. Udział w odłowach i wzrost niektórych gospodarczo ważniejszych ryb jeziora Charzykowo, Jezioro Charzykowo, cz. I., Prace Bad. Inst. Bad. Leśn., 217—244.

Stangenberg M., 1953. Wzrost płoci. Pol. Arch. Hydrobiol., 1 (14), 189—217.

Stangenberg K., 1958. Letni pokarm płoci (*Rutilus rutilus* L.) z jeziora amezotroficznego i dystroficznego. Pol. Arch. Hydrobiol., 4 (17), 251—275.

Starmach K., Chów linów w stawach. Warszawa, Państw. Wyd. Rol. Leś.

Šusta J., 1905. Die Ernährung des Karpfens und seiner Teichgenossen. Stettin, Verl. Herrcke u. Lebeling.

Synek P., 1967. Beitrag zur Systematik der Plötze (*Rutilus rutilus* L.) mit Bezug auf die Veränderungen einiger plastischen Merkmale im Laufe des Wachstums. Věstnik Českoslov. Spol. Zool., 31, 80—87.

Wajdowicz Z., 1968. Próba wsiedlenia troci jeziorowej wdzydzkiej (*Salmo trutta lacustris* L.) do zbiornika zaporowego w Przeczycach. Cz. I. Charakterystyka zbiornika i jego zlewni. — An attempt to aclimatize lake trout from the Wdzydzkie lakes in the dam reservoir at Przeczyce. Part I. Characteristics of the reservoir and its drainage area. Acta Hydrobiol., 10, 395—412.

Wajdowicz W., 1971. Próba wsiedlenia troci jeziorowej wdzydzkiej (*Salmo trutta* m. *lacustris* L.) do zbiornika zaporowego w Przeczycach. Cz. II. Dotychczasowe wyniki wsiedlenia na tle rozwoju ichtiofauny zbiornika (maszynopis — typeswrite).

Westphalen P. J., 1956. Vergleichende Wachstums — und Nahrungsuntersuchungen an Plötzen holsteinischer Seen. Ztschr. Fisch., 5, 61—100.

Włodek J. M., 1966. Studies on the variability of carp populations in ponds. Verh. int. Ver. Limnol., 16, 1435—1439.

http://rcin.org.pl

Zawisza J., B. Karpińska-Waluś, 1961. Wzrost ryb w jeziorze Wdzydze. Roczn. Nauk Roln., 63, D, 133—199.

Zawisza J., 1953. Wzrost ryb w jeziorze Tajty. Roczn. Nauk Roln. 67, D, 221—255.

Žukov P. J., 1965. Ryby Belorussii. Mińsk, Izdat. Nauka i Technika.

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Strona — Page	Tabele — Tables	Zamiast — Instead of	Winno być — Ought to be
335, 340, 341, 342, 343, 344, 346,	I, III, IV, V, VI, VII, VIII (w artykule Niewolaka — in Niewolak's article)	Actinomyces Caseine Rafinose Glicerol Salicine	Streptomyces Casein Raffinose Glycerol Salicin

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338		4	w tekście — in the text	pod ryc. 3 — under fig. 3
356	18, 19 (tytuł — title)		nad lewą częścią — above the left part	nad prawą częścią above the right part
387	6		wynik ujemny	— = wynik ujemny
387	11		= negative result	— = negative result
393	6		picturue	picture
396	11		slegoletkov	siegoletkov
396	17		epizootologii	epizootiologii
397	5		ei-trige	eintrige
399	10		n Przeczyce	in Przeczyce
402		1	Kličavi	Kličava
411		15	to 1 1.42	to 1.42
432	9		przedostawał	przedostał
443		4	Vostradovsky	Vostrodovsky

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