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Systematics

CHARACTERISTIC OF LOWER PHARYNGEAL ARCHES AND FIRST GILL ARCH OF SOME CYPRINIDAE FISH PRESENT IN DĄBIE LAKE AND SZCZECIN FIRTH AS AN ADDITIONAL CRITERION FOR SYSTEMATIC CLASSIFICATION

CHARAKTERYSTYKA KOŚCI GARDŁOWYCH DOLNYCH ORAZ PIERWSZEGO ŁUKU SKRZELOWEGO NIEKTÓRYCH RYB KARPIOWATYCH WYSTĘPUJĄCYCH W JEZIORZE DĄBIE I ZALEWIE SZCZECIŃSKIM JAKO KRYTERIUM POMOCNICZE DLA KLASYFIKACJI SYSTEMATYCZNEJ

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Biometric analysis of the first gill arch and lower pharyngeal arches of bream, blue bream, with bream, grass carp, carp, chub, orfe and roach of Dąbie Lake and Firth of Szczecin origin was carried out. Relations between the standard length and a lower part length of the first right gill arch as well as between the standard length and height of pharyngeal arch were determined by means of regression equations.

INTRODUCTION

The lower pharyngeal arches were recognized as a valuable criterion in classification of *Cyprinidae* fish to a species lewel by Horoszewicz in her work (1960). She gave there differences in shapes of pharyngeal arches for each *Cyprinidae* fish species inhabiting Vistula River.

One of the aim of this work was to compare obtained results concerning characteristic of lower pharyngeal arches to the data cited in the above work and to find out wheather there were any differences between the same fish species from various water basins. Besides present work gives description of lower pharyngeal arches of the two fish species ommited by Horoszewicz (1960), namely blue bream (*Abramis ballerus*) and white grass carp (*Ctenopharyngodon idella*).

Number of gill-rakers onto the first gill arch is regarded by many research workers as a substantial systematic feature. For example, relation between number of fins vertebras and rays and numbers of gill-rakers was noted. For fish inhabiting open waters, as a rule, higher number of gill rakers than for individuals inhabiting coastal waters was observed.

In the present work also the biometric analysis of the first gill arch of tested fish species was carried out. In the hitherto ichtiological works no such detailed study of the above systematic feature has been done.

MATERIALS AND METHODS

Materials for the present work were collected from two connected water basins – the Dąbie Lake and Stettin Firth. All the analysed fish were from fishings done in 1983. Collected and described material includes eight *Cyprinidae* fish species with total number of individuals equal to 214.

In case of material concerning roach, fishing area was additionally taken into consideration – 42 fish were of the Dąbie Lake and 32 individuals of the Stettin Firth origin. The aim of such division was to compare both populations of the same species and to find out if there were defferences between them within the analysed features. Relatively low numbers of grass carp, carp, chub and orfe results from those fish species being only by-catch in the catch.

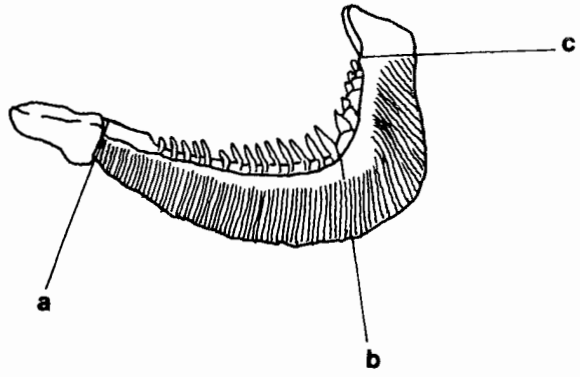
All the tested fish were measured for:

- total length (l.t.)
- standard length (l.c.)
- length of the first right and left gill arch according to the method proposed by Prawdin (1966), and given on Fig. 1
- height of pharyngeal arch
- width of pharyngeal arch

The two last measurable features were basis for counting indexes of pharyngeal arches width.

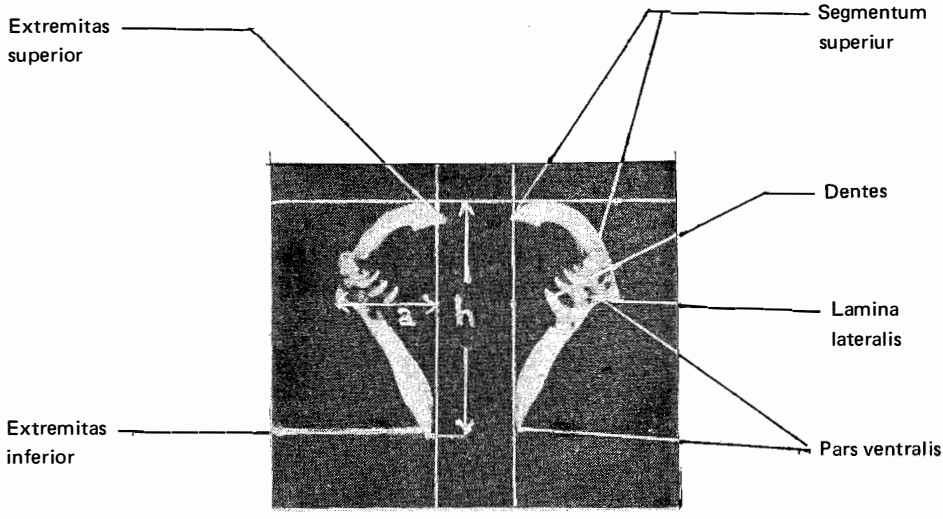
Among meristic features number of gill rakers onto the first right and left gill arch, including lower and upper parts, were counted (Fig. 1) and dentition formula on lower pharyngeal arches studied.

Besides relation between standard length (l.c.) and length of lower part of the first right gill arch for all eight *Cyprinidae* fish species tested has been given in this work.



ab — lenght of lower part of gill — arch
bc — lenght of upper part of gill — arch

Fig. 1. Gill – arch measurements (after Pravdin, 1966)



h — height of arch
a — width of arch

Fig. 2. Position of arch description and measurements

Table 2 presents correlation coefficients and regration equations of the above relation.

Choosing lower segment of gill arch (and not the upper one) as to correlate it with the standard length was due to the values of variability coefficients (v) being substantially lower for that measurable feature (Table 1) than for the upper segment for almost all the fish species tested, which proves the lower part of gill arch to be more stable.

Table 1

Arithmetic means ($\bar{x}$), standard deviations (±S), average means errors (±m), variability coefficients (v) of measurable and denumerable features concerning gill and pharyngeal arches of the tested *Cyprinidae* fish species

Statistic data	Total length (l.t.) (cm)	Standard length (l.c.) (cm)	Gill arch								Pharyngeal arch		
			right				left						
			No. of sp. br.		Length		No. of sp. br.		Length				
			lower part (No.)	upper part (No.)	lower part (mm)	upper part (mm)	lower part (No.)	upper part (No.)	lower part (mm)	upper part (mm)	Height of arch (mm)	Width of arch (mm)	Index of arch width (%)
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Abramis brama (L.) (n = 48)													
Variations range	11.5–38.7	8.1–31.1	15–19	3–6	10.2–33.0	3.2–14.0	16–19	1–6	10.2–33.6	3.3–13.5	6.0–22.5	3.0–12.0	44.0–62.5
$\bar{x}$	33.09	26.40	17.62	4.19	28.35	11.11	17.65	4.17	28.95	11.23	18.61	9.65	51.88
S	6.144	5.146	0.881	0.634	5.010	2.096	0.803	0.920	5.186	2.174	3.533	1.851	3.239
m	0.887	0.743	0.127	0.092	0.723	0.303	0.116	0.133	0.749	0.314	0.510	0.267	0.468
v	18.57	19.49	5.00	15.13	17.67	18.87	4.55	22.06	17.91	19.36	18.98	19.18	6.24
Abramis ballerus (L.) (n = 33)													
Variations range	10.0–39.8	8.4–29.8	22–29	7–12	9.6–35.0	3.3–13.8	20–28	7–16	10.2–35.1	3.0–14.0	6.0–21.0	3.0–10.0	38.8–58.3
$\bar{x}$	28.38	24.08	26.79	8.75	27.79	9.35	26.76	8.82	27.73	9.25	16.86	7.74	46.87
S	7.660	5.143	1.903	1.554	5.788	2.304	2.160	1.546	5.727	2.297	3.427	1.483	4.394
m	1.333	0.895	0.331	0.271	1.008	0.401	0.376	0.269	0.997	0.400	0.597	0.258	0.765
v	26.99	21.36	7.10	17.76	20.83	24.64	8.07	17.53	20.65	24.83	20.32	19.16	9.37
Blicca bjoerkna (L.) (n = 36)													
Variations range	8.5–30.1	6.7–27.8	10–12	3–5	6.6–24.4	2.9–13.0	9–12	4–5	6.4–25.0	3.0–12.7	5.0–22.0	3.0–18.0	42.9–87.5
$\bar{x}$	15.62	12.65	10.14	4.42	12.39	6.04	10.14	4.47	12.37	6.04	9.81	6.92	68.77
S	5.085	4.498	0.350	0.546	3.941	2.261	0.535	0.499	3.981	2.247	4.184	3.656	8.129
m	0.847	0.750	0.058	0.091	0.657	0.377	0.089	0.083	0.663	0.374	0.697	0.609	1.355
v	32.55	35.56	3.45	12.35	31.81	37.43	5.28	11.16	32.18	37.20	42.65	52.83	11.82
Ctenopharyngodon idella Val. (n = 3)													
Variations range	41.7–57.5	36.2–50.7	9–12	5–6	35.8–45.2	18.0–24.3	11	5–6	36.0–46.8	18.8–25.6	29.0–43.0	25.0–34.0	79.1–86.0
$\bar{x}$	48.23	42.03	10.67	5.67	40.76	21.10	11	5.33	39.93	21.96	34.33	28.00	81.89
S	8.247	7.653	1.530	0.580	4.720	3.150	0	0.570	5.970	3.420	7.570	5.190	3.640
m	4.761	4.418	0.883	0.335	2.725	1.819	0	0.329	3.447	1.975	4.371	2.996	2.102
v	17.10	18.21	14.34	10.23	11.58	14.93	0	10.69	14.95	15.57	22.05	18.54	4.44

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Cyprinus carpio L. (n = 7)													
Variations range	9.0–26.5	7.4–21.5	14–16	6–9	10.4–24.0	3.6–11.2	14–16	6–8	10.4–24.0	3.3–11.2	11.0–26.0	5.5–13.0	43.7–52.9
$\bar{x}$	19.86	16.31	15.29	7.0	19.31	8.93	15.14	6.86	19.43	8.61	19.29	9.21	48.14
S	5.727	4.749	0.951	1.290	4.470	2.609	1.069	1.069	4.638	2.640	4.990	2.289	4.418
m	2.165	1.795	0.359	0.488	1.689	0.986	0.404	0.404	1.753	0.998	1.886	0.865	1.670
v	26.57	29.12	6.22	18.43	23.15	29.22	7.06	15.58	23.87	30.66	25.87	24.85	9.18
Leuciscus cephalus (L.) (n = 4)													
Variations range	16.5–31.0	13.2–26.5	6–7	2–4	13.6–26.2	7.2–14.5	5–7	3	13.5–25.2	7.4–22.1	12.0–22.0	8.0–9.5	42.8–66.7
$\bar{x}$	26.27	22.40	6.50	2.75	21.90	11.95	6.00	3	21.30	14.50	19.00	8.87	48.89
S	6.187	6.188	0.577	0.957	5.840	3.350	0.816	0	5.410	6.010	4.690	0.629	11.843
m	3.093	3.094	0.288	0.478	2.920	1.675	0.408	0	2.705	3.005	2.345	0.314	5.926
v	23.55	27.62	8.88	34.80	26.67	28.03	13.60	0	25.40	41.45	24.68	7.09	24.24
Leuciscus idus (L.) (n = 9)													
Variations range	29.8–35.3	25.2–31.6	7–9	4–5	24.4–32.0	12.2–20.0	7–9	4–6	24.4–31.0	12.4–20.2	20.0–24.0	14.0–16.0	63.1–72.7
$\bar{x}$	32.29	27.63	7.78	4.67	28.30	15.68	8.00	4.55	27.95	15.57	22.56	15.17	67.71
S	2.127	2.233	0.670	0.500	3.133	3.035	0.707	0.726	2.750	3.058	1.120	1.000	3.230
m	0.709	0.744	0.223	0.167	1.044	1.012	0.236	0.242	0.917	1.019	0.373	0.333	1.077
v	6.59	8.08	8.61	10.71	11.07	19.36	8.84	15.96	9.84	19.64	4.96	6.59	4.77
Rutilus rutilus (L.) – Dąbie Lake (n = 42)													
Variations range	19.0–38.0	15.0–32.0	6–9	3–5	11.4–26.2	5.2–13.6	6–9	3–5	10.6–25.6	5.4–12.4	13.0–26.0	9.0–20.0	54.5–79.4
$\bar{x}$	23.34	19.31	7.95	3.81	16.43	8.09	8.02	3.88	16.60	8.17	15.57	11.02	70.88
S	3.832	3.419	0.532	0.626	3.064	1.823	0.511	0.498	3.095	1.795	2.703	1.970	3.887
m	0.591	0.528	0.082	0.097	0.473	0.281	0.079	0.077	0.478	0.277	0.417	0.304	0.600
v	16.42	17.71	6.69	16.43	18.65	22.53	6.37	12.83	18.64	21.97	17.36	17.88	5.48
Rutilus rutilus (L.) – Firth of Stettin (n = 32)													
Variations range	15.0–33.2	12.5–28.5	7–9	1–5	10.1–23.3	3.8–10.0	7–9	0–5	10.3–23.1	3.7–9.8	9.0–23.0	7.0–18.0	67.5–83.3
$\bar{x}$	19.92	16.19	8.00	3.84	14.55	6.81	8.00	3.69	14.53	6.71	12.89	9.45	73.68
S	4.528	3.850	0.353	0.666	3.034	1.559	0.433	0.808	3.016	1.525	3.446	2.520	4.954
m	0.800	0.681	0.062	0.118	0.536	0.276	0.077	0.143	0.533	0.270	0.609	0.445	0.876
v	22.73	23.78	4.41	17.34	20.85	22.89	5.41	21.90	20.76	22.73	26.73	26.67	6.72
Extent of variability (d) (roach from Dąbie Lake – roach from Firth of Stettin)													
d	3.44	3.62	0.49	0.20	2.63	3.25	0.18	1.17	2.89	3.77	3.63	2.91	2.64

sp. br. – spines branchiales

Lower pharyngeal arches (Ossa pharyngea inferiora)

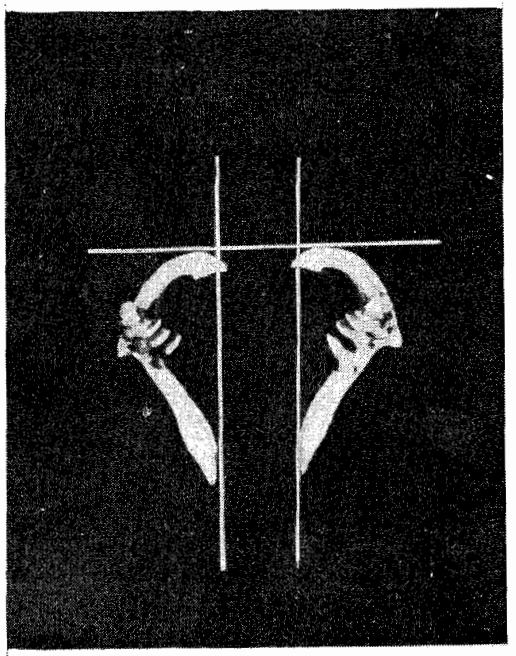


Fig. 3. Bream Abramis brama (L.)

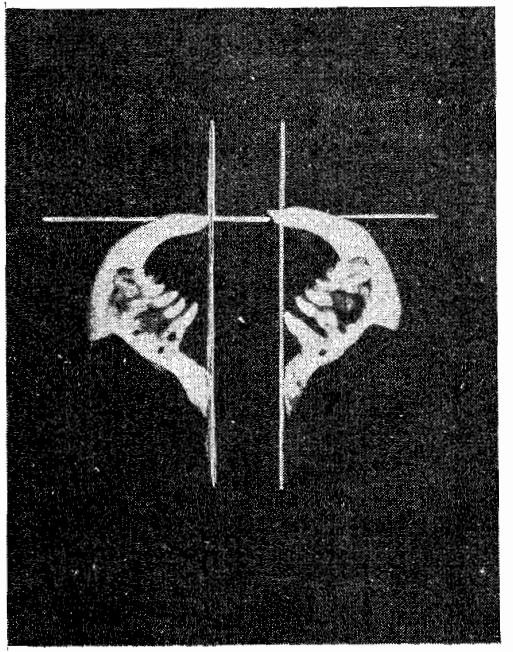


Fig. 4. Blue bream Abramis ballerus (L.)

Also relation between the standard length (l.c.) and hight of gill arch for all the analysed fish species was studied. Correlation coefficients and regression equations of this relation gives Table 4.

To characterize lower pharyngeal arches the descriptions used in Horoszewicz (1960) work were applied. An arrangement of pharyngeal arch for description and for taking measures is presented on Fig. 2.

To compare obtained data of pharyngeal arch width index of the tested fish species, variability coefficients values of that feature were calculated from the data given in the Horoszewicz (1960) work for the fish inhabiting Vistula river and compared with analogical results obtained in the present work.

Extend of variability when comparing roach populations from the Dąbie Lake and Stettin Firth was estimated by means of formula:

$$d = \frac{M_1 - M_2}{\sqrt{m_1^2 + m_2^2}}$$

where:

M_1 and M_2 – arithmetic means for the groups compared,

m_1 and m_2 – standard errors of the respective means.

Biological analysis done for all eight fish species do not include roach, due to a lack of essential differences in biometric features pointed out by Skóra (1964a, b; 1969).

Table 2

Relations between the standard length (l.c.) and a lower part length of the first right gill arch

Fish species	Correlation coefficient	Regression equation
Abramis brama (L.)	0.855	y = 0.8537x + 5.7623
Abramis ballerus (L.)	0.947	y = 1.0897x + 1.7486
Blicca bjoerkna (L.)	0.948	y = 0.8307x + 1.8842
Ctenopharyngodon idella Val.	0.911	y = 0.5621x + 17.1395
Cyprinus carpio L.	0.930	y = 0.8754x + 5.0325
Leuciscus cephalus (L.)	0.976	y = 0.9224x + 1.2373
Leuciscus idus (L.)	0.682	y = 0.9614x + 1.7323
Rutilus rutilus (L.) (Dąbie Lake)	0.813	y = 0.7295x + 2.3431
Rutilus rutilus (L.) (Firth of Stettin)	0.891	y = 0.8282x + 1.1330

RESULTS AND DISCUSSION

Bream – *Abramis brama* (L.)

48 breams of standard length 8.1 – 31.1 cm were tested. Measurements are being gathered in Table 1.

It is worth to be noticed, that only number of gill-rakers onto lower part of gill arch gave relatively low values of standard deviation, variability coefficient and standard error. Other features differed quite visibly.

It was ascertained, that there was a linear relation between the standard length (l.c.) of tested breams and lower part length of the first right gill arch (Tab. 2).

Table 3 includes characteristic of lower pharyngeal arches of the tested *Cyprinidae* fish species. According to it majority of bream individuals has typical dentition formula 5–5. Worth noticing is, that in four cases dentition formula was 1.5–5, which may prove possible crossings between bream and with bream. Such crossing mentions also Horoszewicz (1960) in her work. Also Tadajewska (1980a) working on bream from some Polish water basins stated the domination of fish with dentition formula 5–5. The one with the formula 6–5, 5–6, 5–4 or 4–5 were noted sparsely, while there where only few cases with pharyngeal teeth in two raws.

Relation between the standard length (l.c.) and the hight of pharyngeal arch (h) presented in Table 4 is linear and correlation coefficient between those parameters has high value (r = 0.963).

On Fig. 3 the lower pharyngeal arches of bream are given. Characteristic of those arches (Tab. 3) practically does not differ from the discription given by Horoszewicz (1960) and Jóźwiak (1975). However variability coefficient value of pharyngeal arch width index for bream was equal to 6.24 compared to 9.10 for the same feature in Horoszewicz's work. This may evidence a slightly less variability in lower pharyngeal arches shape of breams from the Dąbie Lake – Stettin Firth area than of Vistula river origin, since number of individuals tested in both works were simillar.

Blue bream – *Abramis ballerus* (L.)

Measures of 33 blue breams were taken; Standard length of the analysed fishes ranged from 8.4 to 29.8 cm (Tab. 1).

The lowest variability coefficient values were obtained, likewise in bream case, for the number of gill-rakers onto lower part of gill arch. Variability coefficients for other features reach relatively high values.

Table 2 presents relation between standard length (l.c.) of blue bream and size of lower part of the first right gill arch. Correlation coefficient of these parameters is characterised by the high value (r = 0.947), relation being rectilinear.

A rectilinear relation was also stated between the standard length (l.c.) and height of pharyngeal arch (Tab. 4) with correlation coefficient of even higher value (r = 0.960).

Table 3

Characteristic of lower pharyngeal arches of the *Cyprinidae* fish species tested

Fish species	Pharyngeal placoid scales				Upper segment position	Upper extremity	Lateral lamina	Ventral part	Lower extremity
	formula	no. of individuals	Percent %	description					
Abramis brama (L.) (n = 48)	5–5 5–4 1.5–5	40 4 4	83.4 8.3 8.3	compressed, hooked, smooth	downward or partially marginal	acute, frequently flattened and broadened	blunt	streight	acute, rarely mildly truncate
Abramis ballerus (L.) (n = 33)	5–5 5–4 4–4 3–3	28 3 1 1	84.9 9.1 3.0 3.0	compressed, hooked, smooth	downward or partially marginal	acute, slightly broadened	blunt	streight	acute, rarely mildly truncate
Blicca bjoerkna (L.) (n = 36)	2.5–5.2 1.5–5.1 1.5–5.2 2.5–5.1 2.5–4.2 2.5–4.0 3.5–5.2	23 4 3 3 1 1 1	63.9 11.1 8.3 8.3 2.8 2.8 2.8	compressed, hooked, smooth	downward or partially marginal	acute, rarely broadened or rounded	acute	streight	acute, rarely mildly truncate
Ctenopharyngodon idella Val. (n = 3)	2.5–4.2 1.5–4.2	2 1	66.7 33.3	compressed, hooked, serrate	marginal	rounded, flattened	outstanding, knee like	streight or slightly arched	sharply truncate or acute
Cyprinus carpio L. (n = 7)	1.1.3–3.1.1	7	100.0	lowered grinded	downward	acute, flattened	out-standing, acute	arched	sharply truncate
Leuciscus cephalus (L.) (n = 4)	2.5–5.2	4	100.0	cone-shaped, hooked, serrate	marginal	acute	hooked, blunt	streight	streightly truncate
Leuciscus idus (L.) (n = 9)	3.5–5.3	9	100.0	cone-shaped, hooked, smooth	marginal, rarely turned downwards	acute	blunt, slightly hooked	streight	streightly truncate
Rutilus rutilus (L.) Dąbie Lake (n = 42)	6–5 5–5 5–6	39 2 1	92.9 4.8 2.3	hooked	downward, rarely mildly marginal	acute	hooked, rarely ro-unded, acute	streight	flattened, streinghtl truncate, rarely mildly rounded
Rutilus rutilus (L.) Firth of Stettin (n = 32)	6–5 5–5	25 7	78.1 21.9	hooked	downward, rarely mildly marginal	acute, sometimes rounded	hooked, acute, rarely rounded	streight	flattened, streightly truncate, rarely mildly rounded

Table 4

Relations between the standard length (l.c.) and height of the pharyngeal arch (h)

Fish species	Correlation coefficient	Regression equation
Abramis brama (L.)	0.963	y = 0.6911x + 0.3650
Abramis ballerus (L.)	0.960	y = 0.6540x + 1.1141
Blicca bjoerkna (L.)	0.856	y = 0.7962x – 0.2688
Ctenopharyngodon idella Val.	0.998	y = 0.9873x + 7.1660
Cyprinus carpio L.	0.973	y = 1.0224x + 2.6055
Leuciscus cephalus (L.)	0.998	y = 0.7565x + 2.0540
Leuciscus idus (L.)	0.434	y = 0.2414x + 15.8861
Rutilus rutilus (L.) (Dąbie Lake)	0.946	y = 0.7479x + 1.1322
Rutilus rutilus (L.) (Firth of Stettin)	0.979	y = 0.8575x + 1.3250

All tested blue bream individuals had single-raw pharyngeal teeth, with domination of dentition formula 5–5 (Tab. 3), like in bream case. General characteristic of blue bream lower pharyngeal arches resembles in substance the bream's one (Fig. 4), with exception for shape of pharyngeal arches somewhat different in both fish species. Results of arch width index equal to 46.87% for blue bream and 51.88% for bream confirm the above observation. Besides the length of edentale segment (segmentum adentale) is worth to be mentioned being visibly shorter for blue bream then for bream.

With bream – *Blicca bjoerkna* (L.)

Analysis were carried out on 36 individuals of standard length (l.c.) 6.7 to 27.8 cm.

The lowest variability coefficient values, alike for blue bream and bream, were obtained for number of gill-rakers onto the lower part of gill arch (Tab. 1). Other analysed features are highly variable.

Also a rectilinear relations between the standard length and the lower part length of the first right gill arch (Tab. 2) as well as between the standard length and pharyngeal arch height were stated, and given correlation coefficients point out to essential connexion between these features.

The with bream lower pharyngeal arches (Fig. 5) are characterized by quite high variability (Tab. 3). As many as seven dentition formulas were stated, while Horoszewicz (1960) and Tadajewska (1980b) had noted three formulas for with breams from Vistula river and Vistula Firth and Jóźwiak (1975) only two for fish from Regalica river.

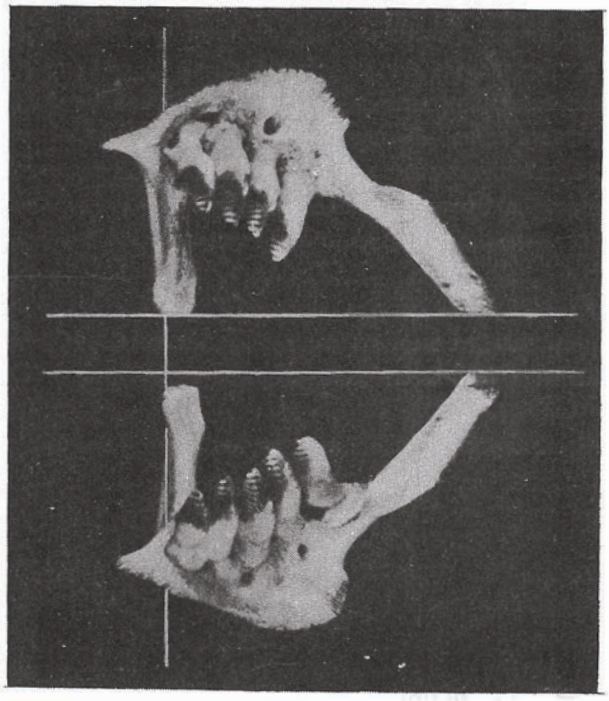


Fig. 6. Grass carp Ctenopharyngodon idella (Val.)

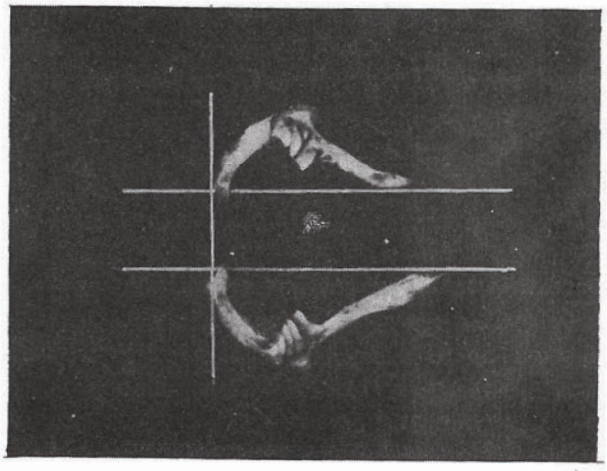


Fig. 5. With bream Blicca bjoerkna (L.)

Lower pharyngeal arches (Ossa pharyngea inferiora)

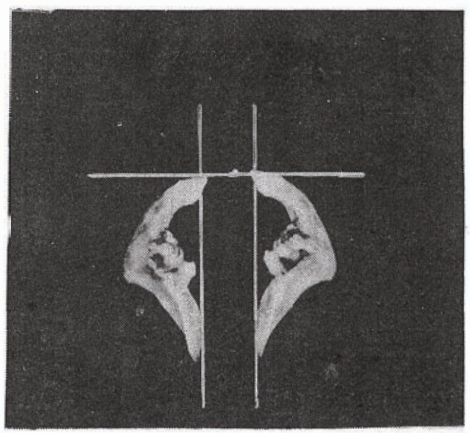


Fig. 7. Carp Cyprinus carpio L.

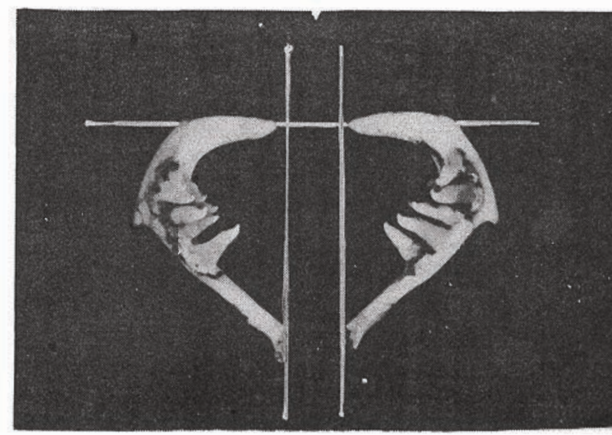


Fig. 8. Chub Leuciscus cephalus (L.)

Among the tested material, alike in case of the cited above works, the dominant were with breams with the dentition formula 2.5–5.2. In the with bream population from the Ilmen Lake aside from the above formulas Dorożkina (1972) found also pharyngeal teeth of 6.1–1.6 formula.

The variability coefficient value of pharyngeal arch width index for with bream was 11.82% being essentially higher from an analogical value counted for fish of the same species from Vistula river (7.6%).

It can prove, there is a higher variability of lower pharyngeal arches in with bream from Dąbie Lake and Firth of Stettin then for fish of the same species from Vistula river. Numbers of fish tested both in the present work and the Horoszewicz one (1960) were very simillar.

Grass carp – *Ctenopharyngodon idella* Val.

Sample includes only three fishes of standard length 36.2 to 50.7 cm, which being representatively small does not let to draw full conclutions. Besides variability coefficients values for analysed features are being high, as a rule (Tab. 1).

The fact worth noticing is that all three fish have steady number of gill-rakers on the lower part of the left gill arch.

An arch angle seems to be a characteristic feature of the grass carp lower pharyngeal arches. It is distinct with a sharp, high outer edge. Its upper segment in marginal position, while upper extremity being rounded or blunt. A lateral lamina outstanding, rounded while ventral part slightly arched or straight with rather sharply cut lower extremity. Pharyngeal teeth in line of formula 2.5–4.2 and 1.5–4.2, characteristically serrate (Fig. 6). High index of pharyngeal arch width equal to 81.89%.

Relations between the standard length (l.c.) and lower part length of the first right gill arch as well as between the standard length and the pharyngeal arch hight (h) are given in Tables 2 and 4.

Carp – *Cyprinus carpio* L.

Sample consists of seven fishes of standard length from 7.4 to 21.5 cm (Tab. 1).

The least variability is characteristic for number of gill-rakers on the lower part of gill arch. Values of variability coefficient for other features are high, as a rule.

Relations between the standard length (l.c.) and a lower part length of the first right gill arch (Tab. 2) as well as between the standard length and the pharyngeal arch height (Tab. 4) are of rectilinear character, with correlation coefficients, for both relations, of high values.

All tested carps has identical dentition formula 1.1.3.–3.1.1. (Fig. 7). General characteristic of the lower pharyngeal arches is very close to description given for tested individuals of this species by Horoszewicz (1960). Only an index value of the pharyngeal arch width is somewhat different – being equal to 48.14%, in our experiment, and 46.5% in the work cited above. Also variability coefficients values for this feature differs slightly

in both elaborations. In the present work this value reached 9.18% and according to the data given by Horoszewicz was 5.87%.

In both works, however, these values were based on relatively low fish number.

Chub – *Leuciscus cephalus* (L.)

Four individuals of standard length from 13.2 to 26.5 cm were measured (Tab. 1). The results however are to be treated cautiously due to low representativeness of the sample.

Nevertheless worth underlining in table 1 is a steady number of gill-rakers on an upper part of the left gill arch.

Correlation coefficients for the standard length and lower part length of the first right gill arch (Tab. 2) as well as standard length and the phyryngeal arch height (tab. 4) relations reached the heighest values among all the analysed fish species.

Characteristic of the chub lower pharyngeal arches (Fig. 8, Tab. 3) is close, in principle, to the description given by Horoszewicz (1960). However an index value of arch width is to be pointed out, being essentially lower (48.89%) in the present work compared to 64.6% in Horoszewicz's work. This very value in Terlecki's and Martyniak's work (1980) for chub from Marózka River near Waplewo was even higher = 67.17%. Also values of variability coefficient counted for this feature both in the present and Horoszewicz's work cited above essentially differ, being, in our work, much higher and equal to 24.24% compared to 6.53% in Horoszewicz one. Compared values may point out to a greater variability in shapes of lower pharyngeal arches in chubs from the Dąbie Lake and Stettin Firth than from the Vistula River.

Orfe – *Leuciscus idus* (L.)

Sample included nine fish of standard length 25.2 to 31.6 cm. Values of variability coefficient for the features presented in Table 1 are relatively low and in three cases only exceed 15%.

The correlation coefficients counted for relations between the standard length and a lower part of the first right gill arch (Tab. 2) as well as between the standard length and pharyngeal arch height (Tab. 4) had the lowest values among all the tested fish species and give an evidence to relatively low rectilinear relation for these features.

Analysis of the orfe lower pharyngeal arches (Fig. 9) did not show greater changes compared to description given by Horoszewicz (1960).

In all the individuals tested one dentition formula 3.5–5.3 was noted. The same dentition formula gave Tadajewska (1980c), while Horoszewicz (1960) presented two formulas for the same species inhabiting Vistula River. Vasarheley (1958) gave some other pharyngeal teeth formulas for orfe, namely: 2.5–5.2, 2.5–5.3, 2.5–5.1, 1.5–5.1. Individuals of such dentition formula, however, constituted insignificant percent of fish tested by this author.

The pharyngeal arch width indexes as well as variability coefficients values for this feature for populations both inhabiting Dąbie Lake and Firth of Stettin as well as

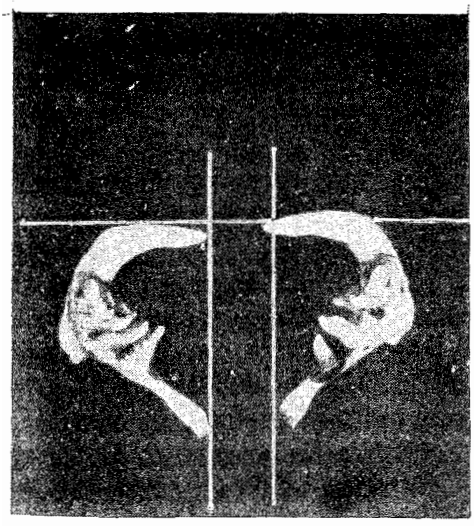


Fig. 9. Orfe Leuciscus idus (L.)

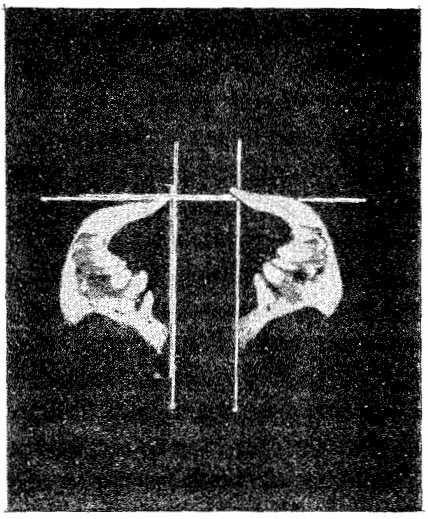


Fig. 10. Reach Rutilus rutilus (L.) – Dąbie Lake

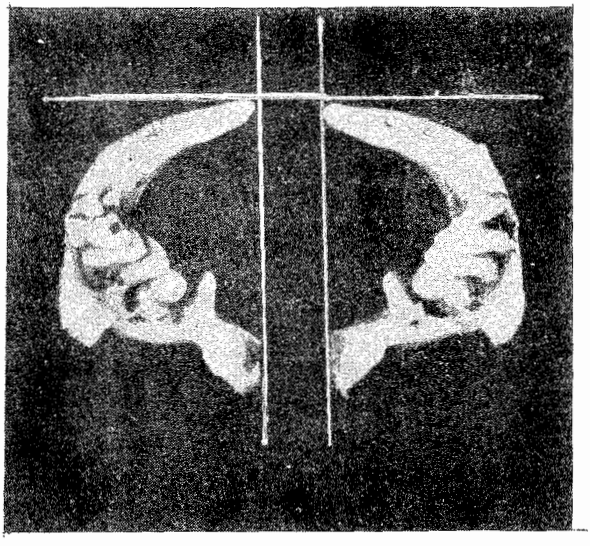


Fig. 11. Reach Rutilus rutilus (L.) – Firth of Stettin

Vistula River (Horoszewicz, 1960) are very close, which may prove there is no essential differences between these populations.

Roach – *Rutilus rutilus* (L.)

Individuals of this species were tested regarding fishing area. Sample included 74 fish altogether, where 42 individuals were of Dąbie Lake origin and 32 of Firth of Stettin.

The lowest variability coefficient values were obtained for number of gill -rakers on lower parts of both right and left gill arches in both populations (Tab. 1). These coefficients values for other features are high, as a rule.

Essential differences between roach populations under comparison (Tab. 1) were noted only for the gill arch upper part length and pharyngeal arch height. No difference was noted in number of gill-rakers on both right and left gill arch.

Characteristic of lower pharyngeal arches (Fig. 10, 11, Tab. 3) within the analysed roach population is being, in principle, very simillar. For roach of Dąbie Lake origin three pharyngeal teeth formula were stated, while for those from Stettin Firth only two. In both populations dentition formula 6–5 dominated. The same dentition formula, as typical and dominant gave Horoszewicz (1960) and Jóźwiak (1975) in their works, with the latter presenting 5 dentition formulas for the roach from Regalica River.

Somewhat greater value of pharyngeal arch width index was obtained for the roach from Stettin Firth (73.68%) than for the one from Dąbie Lake (70,88%).

Also there was a slight difference in variability coefficients of pharyngeal arch width index: being equal 5.48% and 6.72% for roach from Dąbie Lake and Firth of Stettin, respectively. Simillar value of that coefficient (particularly for roach of Dąbie Lake origin) were obtained from the data presented for roach of Vistula River origin in Horoszewicz's work (5.29%). It proves the lower pharyngeal arches shapes to approximate each other in the three mentioned above roach populations.

In both tested roach populations a rectilinear relations between the standard length and a lower part length of the first right gill arch (Tab. 2) as well as between the standard length and pharyngeal arch width (Tab. 4) were found out, with correlation coefficients values for these relations being very high; higher for the fish of Stettin Firth origin at the same time.

CONCLUSIONS

1. There is a rectilinear relation between the standard length (l.c.) and a downward part length of the first right gill arch in bream, blue bream, with bream, grass carp, carp, orfe and roach, with the correlation coefficients (excluding orfe) of high values (Tab. 2).
2. Relation between the standard length (l.c.) and the pharyngeal arch height (h) in the mentioned above fish species is of a rectilinear character, and the correlation coefficients (excluding orfe) being of high values (Tab. 4).
3. The most stable feature for all the tested fish species is the number of gill -rakers on a downward part of the gill arch (Tab. 1).

4. Variability coefficients values of pharyngeal arch width index in the tested fish species compared with analogical values counted for the data given in the Horoszewicz work indicated, that, excluding bream and orfe, to some extend, fish species of Dąbie Lake and Stettin Firth origin show greater variability of this feature than the ones inhabiting Vistula River.
5. General characteristic of lower pharyngeal arches of the tested fish species inhabiting Dąbie Lake and Firth of Stettin is, basically, very close to the description given by Horoszewicz conserning fish species inhabiting Vistula River. Worth mentioning is, however, as much as seven pharyngeal teeth formulas for carp in the present work, compared to three such formulas for carp from Vistula River.
6. Essential differences between the roach populations from Dąbie Lake and Firth of Stettin, refered basically only to the upper part length of gill arch and to pharyngeal arch width. There was no difference in the number of gill-rakers on both right and left first gill arch.

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Stanisław Krzykawski, Leszek Gawliński

CHARAKTERYSTYKA KOŚCI GARDŁOWYCH DOLNYCH ORAZ PIERWSZEGO ŁUKU SKRZELOWEGO NIEKTÓRYCH GATUNKÓW RYB KARPIOWATYCH WYSTĘPUJĄCYCH W JEZIORZE DĄBIE I ZALEWIE SZCZECIŃSKIM

Streszczenie

Celem pracy było scharakteryzowanie kości gardłowych dolnych oraz pierwszego łuku skrzelowego leszcza, rozpióra, krąpia, amura, karpia, klenia, jazia i płoci pochodzących z wód Jeziora Dąbie i Zalewu Szczecińskiego. Łącznie zbadano 214 ryb, które zostały pozyskane z połowów gospodarczych przeprowadzonych w 1983 roku.

Stwierdzono, że zależność pomiędzy długością ciała (l.c.) a długością części dolnej pierwszego prawego łuku skrzelowego u badanych gatunków ryb ma charakter prostolinijny. Wartości współczynników korelacji dla tej zależności, za wyjątkiem jazia, są bardzo wysokie (tab. 2).

Również prostoliniową zależność wykazano dla badanych populacji ryb pomiędzy długością ciała (l.c.) a wysokością łuku gardłowego (h), przy czym współczynniki korelacji osiągnęły, za wyjątkiem jazia, również wysokie wartości (tab. 4).

Najbardziej stałą cechą u wszystkich badanych gatunków ryb okazała się liczba wyrostków filtracyjnych na części dolnej pierwszego łuku skrzelowego (tab. 1).

Z porównania wartości współczynnika zmienności indeksu szerokości łuku gardłowego u badanych gatunków ryb z analogicznymi wartościami obliczonymi na podstawie danych zawartych w pracy Horoszewicz (1960) wynika, że za wyjątkiem leszcza i w pewnym stopniu jazia, pozostałe analizowane gatunki ryb wykazują większą zmienność tej cechy w akwenie wodnym Jezioro Dąbie – Zalew Szczeciński niż w rzece Wiśle.

Ogólna charakterystyka kości gardłowych dolnych badanych gatunków ryb pochodzących z wód Jeziora Dąbie – Zalew Szczeciński jest w zasadzie bardzo zbliżona do opisu podanego przez Horoszewicz (1960) a dotyczącego ryb zasiedlających rzekę Wisłę. Zwraca uwagę jedynie aż siedem wzorów zębów gardłowych u krąpia w badaniach własnych wobec trzech z rzeki Wisły.

Istotne różnice pomiędzy populacjami płoci występującymi w Jeziorze Dąbie i Zalewie Szczecińskim stwierdzono w zasadzie jedynie w odniesieniu do długości części górnej łuku skrzelowego oraz wysokości łuku gardłowego. Nie stwierdzono natomiast różnicy w liczbie wyrostków filtracyjnych na prawym i lewym pierwszym łuku skrzelowym.

Станислав Кшикавски, Лешек Гавлиньски

ХАРАКТЕРИСТИКА НИЖНИХ ГОРЛОВЫХ КОСТЕЙ И ПЕРВОЙ ЖАБЕРНОЙ ДУГИ НЕКОТОРЫХ ВИДОВ РЫБ СЕМЕЙСТВА КАРПОВЫХ, ОБИТАЮЩИХ В ОЗЕРЕ ДОМБЕ И ЩЕЦИНСКОМ ЗАЛИВЕ

Р е з ю м е

Целью работы было получение характеристики нижних горловых костей и первой жаберной дуги леща, сопы, густеры, белого амура, карпа, головля, яза, и плотвы, обитающих в озере Домбе и Щецинском заливе. Всего исследовали 214 особей, которые были взяты из промышленных уловов, проводимых в 1983 г.

Установлено, что соотношение между длиной тела (l.c.) и длиной нижней части первой правой жаберной дуги у исследуемых видов рыб имеет прямолинейную зависимость. Величины коэффициентов корреляции для этой зависимости, за исключением яза, очень высокие (Табл.2).

Также прямолинейная зависимость наблюдалась у исследуемых популяций рыб между длиной тела (l.c.) и высотой горловой дуги (h), причём коэффициенты корреляции достигли, за исключением яза, также высокой величины (табл.4).

Наиболее постоянной характеристикой у всех исследуемых видов рыб являлось число фильтрационных отростков на нижней части первой жаберной дуги (Табл.1).

Из сравнения величин коэффициента изменяемости индекса ширины горловой дуги у исследуемых видов рыб с аналогичными величинами, определёнными на основе данных, находящихся в работе Хорошевич (1960г.), вытекает следующие, что за исключением леща и в некоторой степени яза, остальные анализированные виды рыб демонстрируют большую изменчивость этой характеристики в водном аквене озеро Домбе - Щецинский залив, чем в реке Висле.

Общая характеристика нижних горловых костей исследуемых видов рыб, обитающих в озере Домбе - Щецинском заливе, в основном близка характеристике, данной Хорошевичем (1960 г.) для рыб, обитающих

в реке Висле. Единственная разница в описании наблюдается между наличием 7 форм горловых зубов у густеры (в настоящих исследованиях) и 3 форм (из реки Вислы).

Существенные различия между популяциями плотвы обитающей в озере Домбе и Щецинском заливе, обнаружены только лишь касающиеся длины верхней части жаберной дуги и высотой горловой дуги, Разници между числом фильтрационных отростков на правой и левой жаберной дуге не обнаружено.

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