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**FOOD OF BREAM, *ABRAMIS BRAMA* (L.), AND WHITE BREAM,  
*BLICCA BJOERKNA* (L.), IN ZEGRZYŃSKIDAM RESERVOIR**

**POKARM LESZCZA (*ABRAMIS BRAMA* L.) I KRAPIA (*BLICCA BJOERKNA* L.)  
W ZBIORNIKU ZEGRZYŃSKIM**

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Studies were carried out in 1987 and 1988 on the content of food tracts of 636 breams and 537 white breams from Zegrzyński Dam Reservoir. Samples were collected from three stations: Wierzbica, Bug and Zegrze. The fish fed mainly on *Chironomidae* (larvae and pupae) and *Mollusca*. *Chironomus* sp. and *Glyptotendipes* sp. were the two most frequently consumed genera from among the *Chironomidae* larvae.

INTRODUCTION

Bream and white bream inhabit inland water bodies lowland rivers and marine lagoons. The two species are very similar morphometrically and are characterized by similar feeding behaviour (Brabrandt 1984, Lammens 1982, Lammens 1984, Rask 1989, Wielgosz, Tadaiewska 1988). Along with increasing eutrophication the two species become most important components of the fish stock biomass in the water bodies. Polish literature does not have many papers on these two fish species in dam reservoirs (Klimczyk-Janikowska 1974, Martyniak et al., 1987, Wielgosz, Tadaiewska 1988), lakes (Prejs 1973, Budzyńska et al., 1956) or rivers (Pliszka 1981, Terlecki et al., 1977). This paper represents a part of complex studies on feeding relations in fish of Zegrzyński Dam Reservoir (the project was financed by the Institute of Ecology of the PA S). The aim of the study was to determine the diet of bream and white bream at three stations in Zegrzyński Dam Reservoir.

Bream diet was extensively studied in the Soviet Union, most of all in dam reservoirs (Bakanov, Strižnikova 1979, Jegerewa 1960, Klučarewa 1960, Nebolsina 1962, Kogan 1963, Ermolin 1979). Some papers on bream diet in three dam reservoirs Mostišťe, Lipno and Dalešiče, (Kokeš, Gajdušek 1978, Lohniský 1965, Adámek et al., 1987) were published in Czechoslovakia.

## CHARACTERISTICS OF THE ENVIRONMENT

Zegrzyński Dam Reservoir was constructed by damming Narew and Bug rivers at Dębe. Its area is about 33 km<sup>2</sup>, length 60 km, breadth from 0.5 to 3 km, average depth 3.5 m, depth near the dam about 9 m. Variations of water level near the dam reach about 0.5 m (Kajak 1990 b). In upper part of the reservoir it is possible to distinguish two sleeves embracing end sectors of the former rivers Narew and Bug, extending to the place when the two rivers joined. In the middle part of the reservoir there is an overflowed area with water current running along right bank and still water along the left bank. Below this area to the dam the reservoir is much narrower (Fig. 1).

Water flow through the reservoir is about 1 day at low water level to several days at high levels. Water retention time in the middle part is always longer than in the part with water current. Waters of the Narew River flow more rapidly than those of Bug, but the flow decreases at the last 15 km before the two rivers join. This results in the fact that the rate of water flow at the inflow of Bug River to the reservoir is more rapid than in the Narwian part. In the flooded area of the reservoir water flow is slowed down a few times (Simm 1990, Kajak 1990 b). Water mixing takes part over the whole reservoir. In the central part water mixing is enhanced by the current. As a result oxygen conditions for fish are very good (Grudniewski, Boroń 1990, Kajak 1990 a). Shore line of the reservoir is very developed. Right bank is formed by natural hills, left bank and the east arm is surrounded by a dike with cemented slopes. Waters of the main inflows as well as of the reservoir are very rich. Concentrations of the basic parameters were higher in Bug than in Narew River (Kajak 1990 b). Hydrochemical studies revealed also that Bug River was more polluted by sewage and agriculture than Narew River (Jakubowska 1968). The same taxa of central diatoms and green algae *Chlorococcales* dominated in Narew and Bug waters. Biomass of green algae increased, and of diatoms decreased with decreasing water flow rate in the reservoir (Simm 1990).

Zooplankton in Zegrzyński Reservoir was characterized by high number of the species and considerable differentiation of the ecological groups. This was also due to significant input of zooplankton with Bug and Narew waters, and to limnological

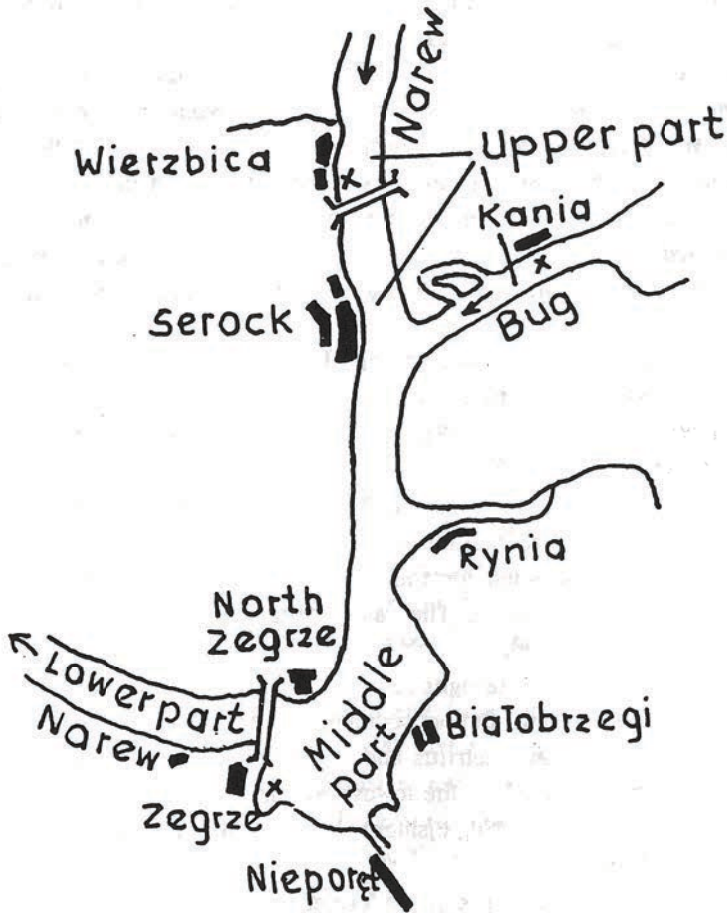


Fig. 1. The Zegrzyński Reservoir – location of sampling stations

character in the central and lower part of the reservoir. Due to low water flow in the latter part production of zooplankton is very intensive (Ejsmont-Karabin, Węgleńska 1990).

Feeding conditions for the zooplankton are good due to high phytoplankton biomass, constant inflow of organic matter to the reservoir and low pressure of invertebrate predators (Simm 1990, Ejsmont-Karabin, Węgleńska 1990). Average biomass of rotifers and crustaceans is the highest in the central part of the reservoir, with the domination of crustaceans, on the average  $1.86 \text{ mg dm}^{-3}$ , followed by the part of former Bug River (with the domination of crustaceans,  $0.48 \text{ mg dm}^{-3}$  on the average). The lowest biomass was noted in the former Narew River (with the domination of crustaceans,  $0.23 \text{ mg dm}^{-3}$  on the average). Maximal concentrations of the zoo-

plankton in this reservoir were comparable to zooplankton densities in hypertrophic lakes (Ejsmont–Karabin, Węgleńska 1990). Also numbers and biomass of benthic organisms reached high values. The main taxonomic groups were *Mollusca*, *Oligochaeta* and *Chironomidae*, and within the latter *Chironomus* f.l. plumosus, *Procladius* sp. and *Glyptotendipes* e.g. *gripekoveni* (Dusoge et al. 1990, Kuklińska 1989). Numbers of *Chironomidae* larvae were especially high in the first part of the vegetation season (May–June). In the Bug River part of the reservoir *Chironomidae* biomass reached  $850 \text{ g m}^{-2}$ , over 70 thousand individuals (Kuklińska 1989). Mollusca were more numerous in the part with water flow compared to the still water part (Dusoge et al. 1990).

It should be mentioned that thermal conditions and water inflow differed in particular years. In 1988 the vegetation season was longer; there were also more days with  $20^\circ\text{C}$  than in 1987. Water inflow in 1988 was higher than in 1987 ( $9.955 \times 10^6$  cubic m,  $7.375 \times 10^6$ ) (Kajak 1990 b). Bream and white bream as well roach were dominating in the experimental catches (Grudniewski, Boroń 1990) and in the commercial ones.

In view of different environmental conditions in particular parts of the reservoir, sampling stations were selected for the two fish species under study. Fish were caught on three fishing grounds. The same stations were used in the studies on bottom fauna (Kuklińska 1989).

a) Wierzbica – located on the right bank of the former Narew River, up the bridge on the road Serock–Wyszków. Bottom sediments up to 1 m were sandy in this place, while deeper layers contained detritus and a few cm loose mud (Kuklińska 1989). This station was characterized by the lowest biomass of phyto- and zooplankton as benthos (Kajak 1990 a, Simm 1990, Ejsmont–Karabin, Węgleńska 1990, Dusoge et al. 1990, Kuklińska 1989).

b) Bug – located at the left bank of the former Bug River. This station was characterized by steep sloping of the bottom and no submerged vegetation. Bottom at the depth of 1–2 m was covered with loamy layer of mud of several cm (Kuklińska 1989). This station was very fertile, with average biomass of photo- and zooplankton and the highest density and biomass of "soft" bottom fauna (Kajak 1990 a, Simm 1990, Ejsmont–Karabin, Węgleńska 1990, Dusoge et al. 1990, Kuklińska 1989).

c) Zegrze – located in the south part of the reservoir, at the height of Zegrze village. Bottom at the depth of 1–2 m is sandy, covered with a few cm of mud, with remnants of shells, mostly of *Dreissena polymorpha* and *Viviparus* sp. This station was characterized by average fertility, the lowest water flow and average of zooplankton and benthos biomass (Ejsmont–Karabin, Węgleńska 1990, Dusoge et al. 1990, Kuklińska 1989).

## MATERIAL AND METHODS

Materials were collected in 1987 and 1988. Samples were taken every month since April till October. Fish were caught with gill nets of size 40 to 160 mm. Fish were weighed up to 10 g and body length was measured (*longitudo corporis*), 636 food tracts of bream were collected (Tab. 1) and 537 of white bream (Tab. 2).

It was not possible to collect materials of the two species at all stations each month.

Collected food tracts were preserved in 4% formalin. Content of each food tract was viewed under a stereoscope microscope determining bigger food components. *Chironomidae* which dominated in the food were determined to the lowest possible systematic category. Samples were taken from each food tract for determination of *Oligochaeta* bistles. Mass of eaten components was calculated from the formula  $W = K L^3$  (Morduchaj-Boltovskoj 1954). For most *Chironomidae* larvae  $K = 3.5$ ; only for *Procladius sp.* and *Cryptochironomus sp.*  $K = 7$ .

Molluscs in the food tracts were damaged. They were very smashed by pharyngeal teeth. In most cases it was impossible to determine species of these food components so they were determined as *Mollusca*. Their biomass (together with crustaceans) was calculated using a percentage method (volume-point) from known food weight.

Apart from the main food components items from other systematic groups were also found in the food tracts, as also non-calculable components (plants); they are presented in Table 3. Rare prey organisms (and sometimes their parts) belonged to such systematic units as *Cladocera*, *Ephemeroptera*, *Isopoda*, *Arachnida*, *Cestoda* and *Oligochaeta*. Since they were sporadic their biomass was not calculated, and their occurrence was denoted as "+" (Tab. 3).

In order to facilitate interpretation of the results, samples from each month was treated as a whole for each species (it was not divided into size classes).

In addition to the biomass calculations were also made of the numbers, frequency of occurrence and indices of filling. Biomass of the food consumed was divided into the following prey categories: *Chironomidae* larvae, *Chironomidae* pupae, *Mollusca* and *Ceratopogonidae*, and other larvae (eg. *Sialis sp.*). In the case of the share in numbers all food components were divided into the following categories: *Chironomus sp.* larvae, *Glyptotendipes sp.* and other *Chironomidae*, non-identified *Chironomidae* and *Chironomidae* pupae. Determinations of the importance of particular food components in the diet they were divided into the following groups: eudominants, when the component represented 50.1–100%, dominants from 20.1 to 50% subdominants from 5.1 to 20%, rare organisms 1.1–5%, and sporadic components below 1% of the biomass or numbers.

Table 1

Characteristic of the collected materials — *Abramis brama* L.

Year	Month	Station	Range of body length in cm (lc)	Number of collected tracts	% of full
1987	IV	Wierzbica	15.1–30.0	13	30
	V		20.1–45.0	26	65
	VII		25.1–35.0	23	26
	VIII		25.1–40.0	22	77
	X		15.1–45.0	18	27
1988	IV	Wierzbica	15.1–25.0	25	20
	V		15.1–45.0	36	27
	VI		30.1–40.0	14	28
	VII		30.1–40.0	13	7
	IX		15.1–40.0	64	6
	X		15.1–40.0	55	9
1987	VI	Bug	25.1–40.0	19	68
	VII		20.1–35.0	24	41
	IX		20.1–35.0	10	70
	X		15.1–43.5	35	34
1988	IV	Bug	20.1–30.0	4	75
	V		15.1–40.0	56	12
	VI		20.1–35.0	10	40
	VII		20.1–40.0	12	66
	VIII		25.1–30.0	9	44
	IX		15.1–40.0	24	58
X	30.1–40.0	13	76		
1987	IV	Zegrze	20.1–35.0	14	35
	V		20.1–40.0	24	91
	VI		35.1–40.0	11	63
	VII		35.1–40.0	7	71
	IX		35.1–40.0	12	83
	X		25.1–42.0	25	13
1988	IV	Zegrze	30.1–45.0	27	51
	VI		25.1–35.0	12	75
	X		30.1–35.0	14	7
1987 – 1988		Total		636	41,9

Table 2

Characteristic of the collected materials — *Abramis brama* L.

Year	Month	Station	Range of body length in cm	Number of collected tracts	% of full
1987	IV	Wierzbica	15.1–25.0	9	33
	V		15.1–25.0	21	38
	VI		15.1–30.0	42	43
1988	V	Wierzbica	15.1–25.0	25	24
	VI		15.1–25.0	21	9
	IX		15.1–30.0	28	3
	X		15.1–30.0	21	14
1987	IV	Bug	15.1–25.0	24	79
	V		15.1–30.0	26	53
	VI		15.1–25.0	18	72
	VII		10.1–25.0	36	38
	IX		20.1–30.0	13	38
	X		15.1–30.0	37	8
1988	IV		10.1–30.0	47	75
	V		15.1–30.0	35	45
	VI		15.1–25.0	29	41
	VII		15.1–25.0	30	30
	VIII		20.1–30.0	30	23
	IX		15.1–40.1	41	41
	X		15.1–20.0	4	50
1987 – 1988		Total		537	44.8

## RESULTS

The following species were determined in the group other Chironomidae: *Cryptochironomus* sp., *Procladius* Skuse, *Tanytarsus* eg gregarius, *Endochironomus* eg tendens, *Polypedilum* ex grege nubeculosum, *Criptopus* sp., *Limnochironomus* sp., *Strictochironomus* sp.

Table 3

Comparison of biomass of food items in *Abramis brama* L. and *Blicca bjoerkna* L. diet in 1987 and 1988 in Zegrzyński Reservoir

Food items	Biomass in mg															
	<i>Abramis brama</i> L.								<i>Blicca bjoerkna</i> L.							
	1987				1988				1987				1988			
Number of examined individuals n	144				123				96				145			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
<i>Chironomus sp. larvae</i>	40176	76.35	9.2	0.02	18373	65.45	8.0	0.04	16453	79.85	6.3	0.03	13130	66.53	6.6	0.05
<i>Glyptotendipes gripekovenii</i> K.	3950	7.51	3.6	0.09	8439	30.06	2.8	0.03	1400	6.79	5.0	0.36	3486	17.66	4.2	0.12
<i>Procladius sp.</i>			1.7	0.43			1.6	0.86			1.8	1.81			1.9	13.5
<i>Cryptochironomus sp.</i>			1.9	0.49			0.8	0.43			3.3	3.33				
<i>Endochironomus sp.</i>															2.5	17.85
<i>Polypedilum sp.</i>							0.8	0.43							0.8	5.7
<i>Chironomidae larvae</i> (others)	387	0.73			184	0.66			99	0.48			14	0.07		
<i>Chironomidae larvae</i> n. det.	913	1.73							668	3.24						
<i>Chironomidae pupae</i>	336	0.64			59	0.21			419	2.04			675	3.42		
<i>Mollusca</i>	6860	13.04			1002	3.57			1566	7.60			2420	12.26		
<i>Ceratopogonidae</i> and others larvae					16	0.05							12	0.06		
<i>Cladocera</i>					+											
<i>Ephemeroptera</i>					+											
<i>Isopoda</i>					+											
<i>Diptera</i> n.det.	+				+								+			
<i>Insecta</i>	+								+							
<i>Arachnida</i>									+							
<i>Cestoda</i>	+				+				+							
<i>Oligochaeta</i>	+															
<i>Macrophyta</i> n. det					+								+			
<i>Algae</i> n. det					+								+			
sand					+				+				+			
Total	52622	100.00			28073	100.00			20605	100.00			19737	100.00		

1 - biomass of food item, 2 - % of total biomass, 3 - average weight of food item, 4 - % of each food item.



## I. Bream

Characteristics of bream under study are given in Table 1. Apart from the dates of sampling and range of body lengths the table gives per cent of full food tracs. Index of filling with food is presented in Fig. 2. The highest per cent of full food tracs was found in Zegrze station in May 1987 (91%) and in September of the same year at the same station (83%). The lowest values of this index were found in September 1988 at station Wierzbica (6%) and in October 1988 at station Zegrze (7%). The highest index of filling was found in July 1987 at station Wierzbica and Bug (49%..) the lowest (7%..) was observed in April 1987 at station Wierzbica (Fig. 2).

*Chironomidae* larvae were the main components of bream diet. *Chironomus sp.* larvae represented main components of food biomass both in 1987 (76.35%) and 1988 (64.45%). *Glyptotendipes* larvae were on the second place in bream diet. In 1988 they were more numerous than in 1987 and they represented 30.6% of the biomass (Tab. 3). On station Wierzbica molluscs were also consumed.

### Station Wierzbica

No data were collected on this station for two months in 1987 (June and September). Bream diet in April, July, August and October consisted of *Chironomidae* larvae. Only in May *Mollusca* were the main component, while *Chironomidae* larvae became a subdominant component (12.8% of the biomass) (Fig. 3). *Chironomus sp.* larvae were the most frequent component (52%); *Glyptotendipes sp.* larvae were present as dominants (36.6%) (Fig. 4). *Chironomus sp.* larvae were present as an eudominant in the samples collected in April (60.8%), July (80.7%) and October (93.7%) (Fig. 4), *Glyptotendipes sp.* larvae were present as dominants in the samples collected in August (47.5%) and May (36.6%). Larvae of other *Chironomidae* were present as dominants in April (21.4%). Larvae of unidentified *Chironomidae* were present as subdominants in the samples collected in April (17.8%), July (16.9%) and August (15.8%) (Fig. 4).

No data for bream were obtained in April and August 1988 at Wierzbica station. In May and September *Mollusca* were an eudominant in bream diet. In June, July and October bream diet consisted mainly of *Chironomus sp.* larvae (47%) and larvae of other *Chironomidae* which constituted the dominants (45%) (Fig. 4).

In October *Glyptotendipes sp.* larvae were the eudominants (94.7%) in bream diet. The rest of bream food in this month was represented by *Chironomus sp.* larvae (5.3%) (Fig. 4).

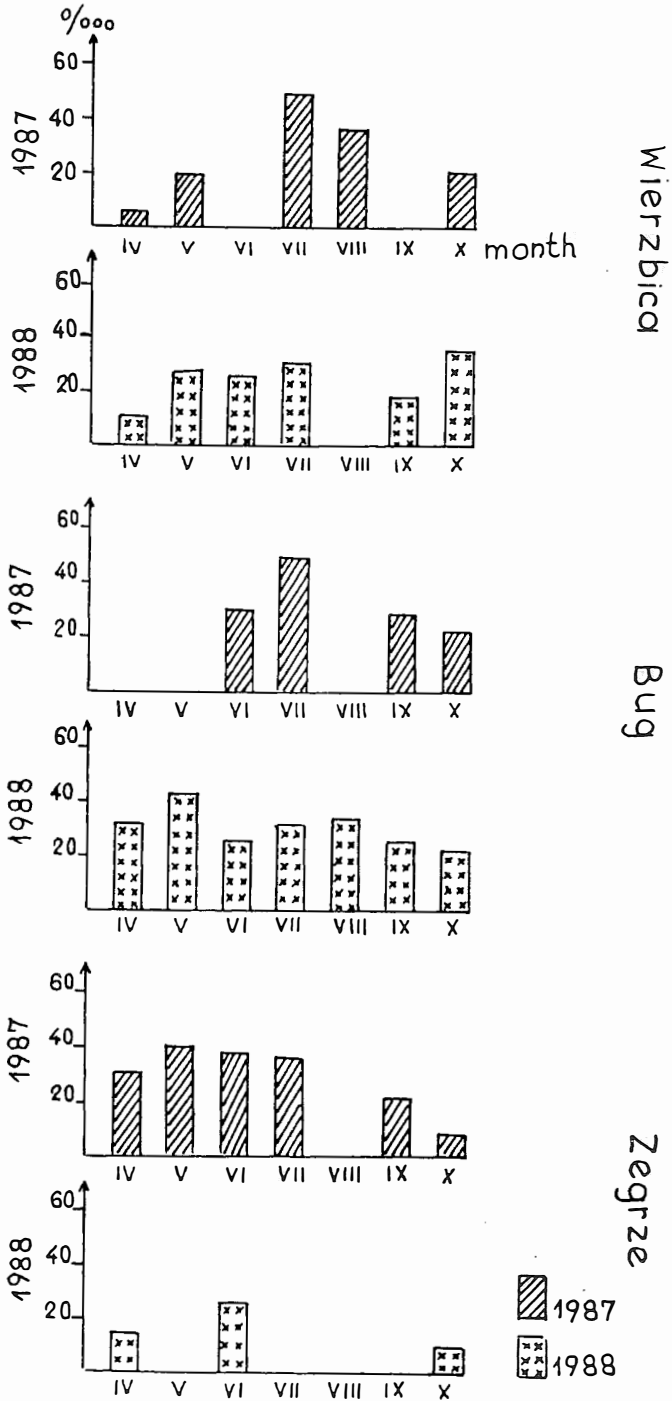


Fig. 2. Index of fullness of bream food tracts

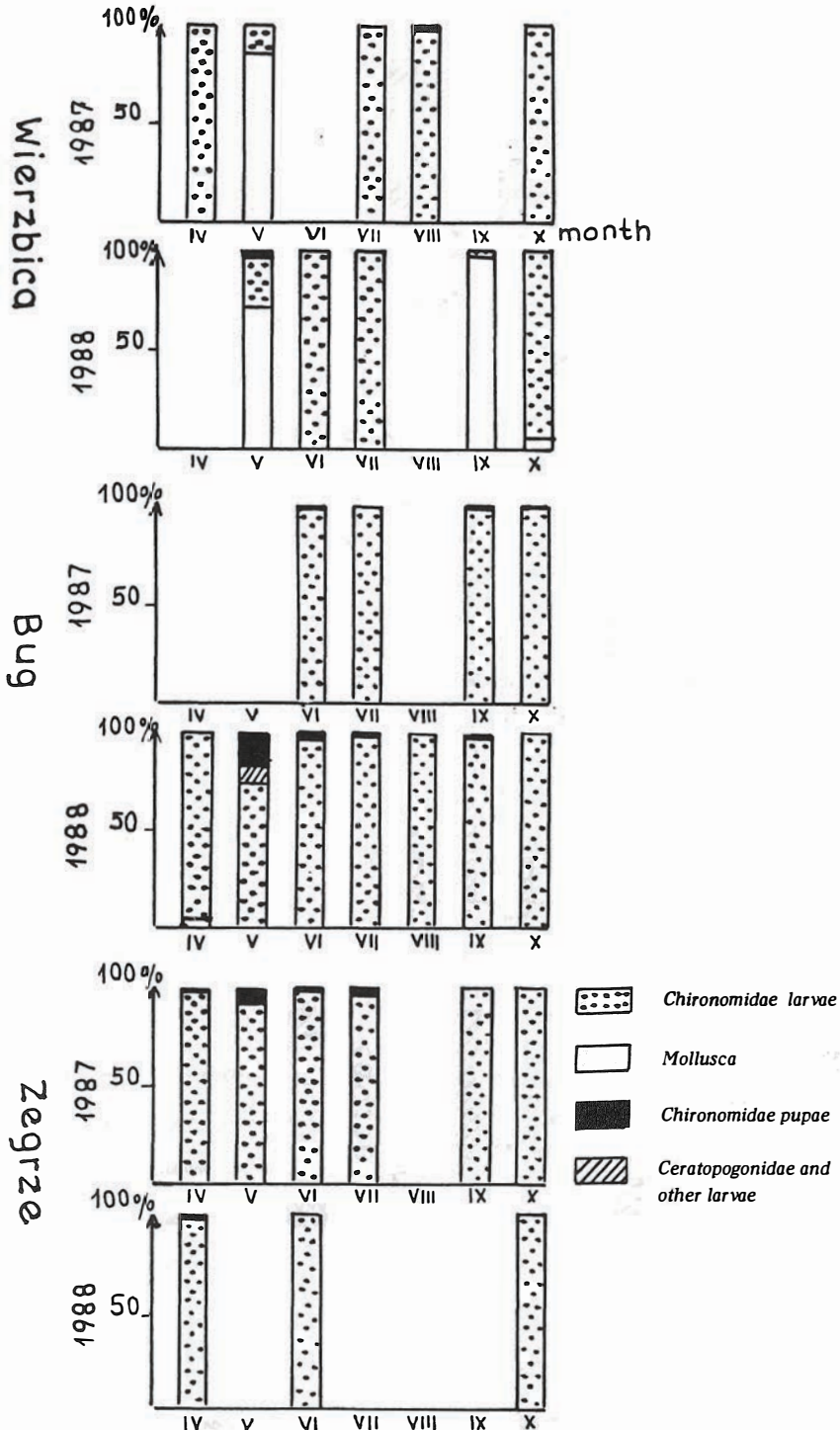


Fig. 3. Weight percentage of food components of bream

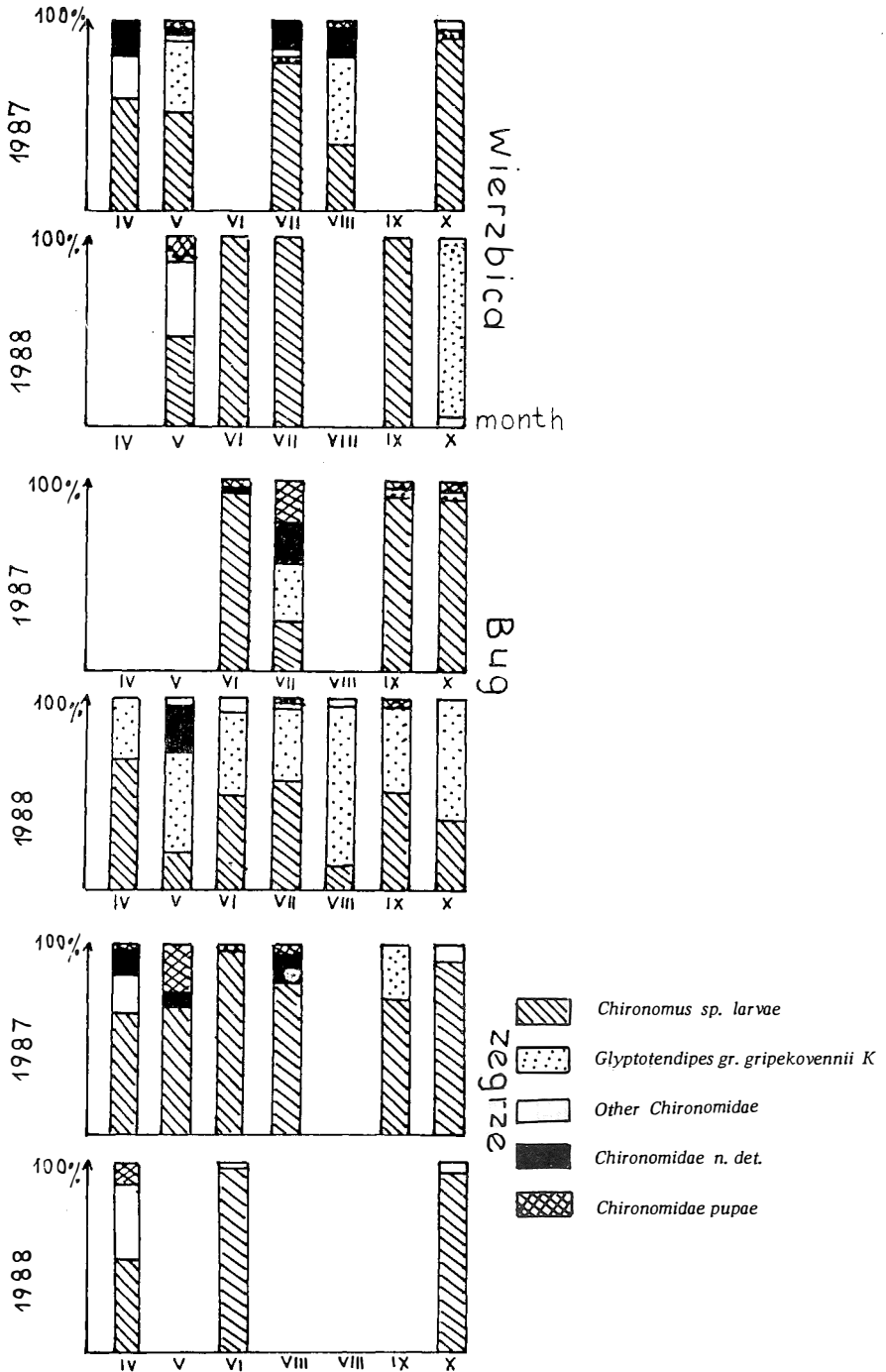


Fig. 4. Number percentage of food components of bream

### Station Bug

At this station no data were collected for bream in April, May and August 1987, *Chironomidae* larvae were the main component of the diet. They were eudominants in June, September and October (Fig. 4).

*Chironomidae* pupae and larvae of unidentified *Chironomidae* were present as numerous components (less than 5%). In July samples 4 food components were present as dominants: larvae of *Glyptotendipes sp.* (31.7%) and of *Chironomus sp.* (26.7%), unidentified *Chironomidae* (26%) and pupae (21%) (Fig. 4).

In 1988 bream samples were collected on this station in all months (April–October). *Chironomidae* larvae were the main food components in all cases (Fig. 3). *Chironomus sp.* and *Glyptotendipes sp.* larvae were most frequent (Fig. 4). *Mollusca* were found only in April as an infrequent components (less than 5% of the biomass). Pupae were present in some months: May, June, July and September. They were most numerous in May, 16.5% of the food biomass (subdominant) (Fig. 4). In the other months (June, July and September) they were infrequent (up to 5% of the biomass) (Fig. 3).

*Ceratopogonidae* larvae appeared in May sample but they were infrequent, only 4% of the biomass.

*Chironomus* larvae were an eudominant in April (68%), July (58%) and September (51.3%), and they dominated in June (49.8%) (Fig. 4).

*Glyptotendipes* larvae were present as eudominant in August (87%) and October (64%), and as dominants in April (32%), May (48.3%), June (42.9%), July (41%) and September (48%) (Fig. 4).

Larvae of unidentified *Chironomidae* were present as subdominants in May (15.7%).

### Station Zegrze

Only bream samples were collected from this station. In 1987 no sample was collected in August. *Chironomidae* larvae were the main component. Pupae appeared in 4 months only: April, May, June and July. Pupae were least frequent in April (0.4% of the food biomass) and most numerous in May (8.8%) (Fig. 3). *Chironomus sp.* larvae were an eudominant in all months (Fig. 4). In April larvae of other *Chironomidae* were the dominant (21.3%), in May their place was taken by pupae (26.2%), and in September by *Glyptotendipes sp.* larvae (30.5%).

Larvae of unidentified *Chironomidae* were present as subdominants in April (13.4%) and July (14%). In October larvae of other *Chironomidae* appeared in bream diet as the subdominants (8%).

In 1988 only 3 samples were obtained: in April, June and October. *Chironomus sp.* larvae dominated in April sample (eudominant – 55%) together with the larvae of other *Chironomidae* (dominant – 39%). Pupae were the subdominants (10.3%) (Fig. 4).

In June and October *Chironomus sp.* larvae were the eudominant. Larvae of other *Chironomidae* were also found. In June they were present in minimal amounts (1% of the numbers) and in October they became a subdominant (6.3%) in bream diet (Fig. 4).

## II. White bream

In the case of white bream most full food tracs were found in April 1987 (79%) and 1988 (75%) at station Bug (Tab. 2). The highest number of empty food tracs was observed in September 1988 at station Wierzbica. The highest index of filling was noted at this station in the same year (85.3%..). The lowest value of the index of filling was found at station Bug in October 1987 (5.7%..) (Fig. 5).

Food of white bream was composed mostly of *Chironomus sp.* larvae. They were an essential food component in 1987 and 1988 (Tab. 3). *Glyptotendipes* larvae were much more numerous in 1988 (17.66%) than in 1987 (6.7%) (Tab. 3). In 1988 white bream consumed more Mollusca (12.26%) than in 1987 (7.6%).

White bream samples were collected at two stations: Wierzbica and Bug.

### Station Wierzbica

In 1987 data for white bream were collected only in April, May and June. Chironomidae larvae and Mollusca were main components of white bream diet. In April and May this fish fed only on Mollusca. In June white bream fed on *Chironomidae* larvae and pupae (Fig. 6). *Chironomus sp.* larvae decisively dominated in the diet (eudominant) and unidentified *Chironomidae* larvae and pupae were present as infrequent components (less than 5% of the number) (Fig. 7).

In 1988 no white bream samples were collected in April, July and August, Mollusca were present in diet in May and October. In June and September white bream food was composed of *Chironomidae* larvae (Fig. 6). *Chironomus sp.* larvae represented 100% of the food biomass (Fig. 7).

### Station Bug

*Chironomidae* larvae and pupae constituted white bream food. In 1987 no data were collected in August, *Chironomus sp.* larvae were the main food component. They were present as an eudominant in April (82%), May (53.4%), June (97.8%), September (89.5%) and October (100% of the numbers) (Fig. 7). These larvae were the dominants in July sample (50%). *Glyptotendipes* larvae were present as subdominants in April sample (11.5%), May sample (12.2%) and as a dominant in July sample

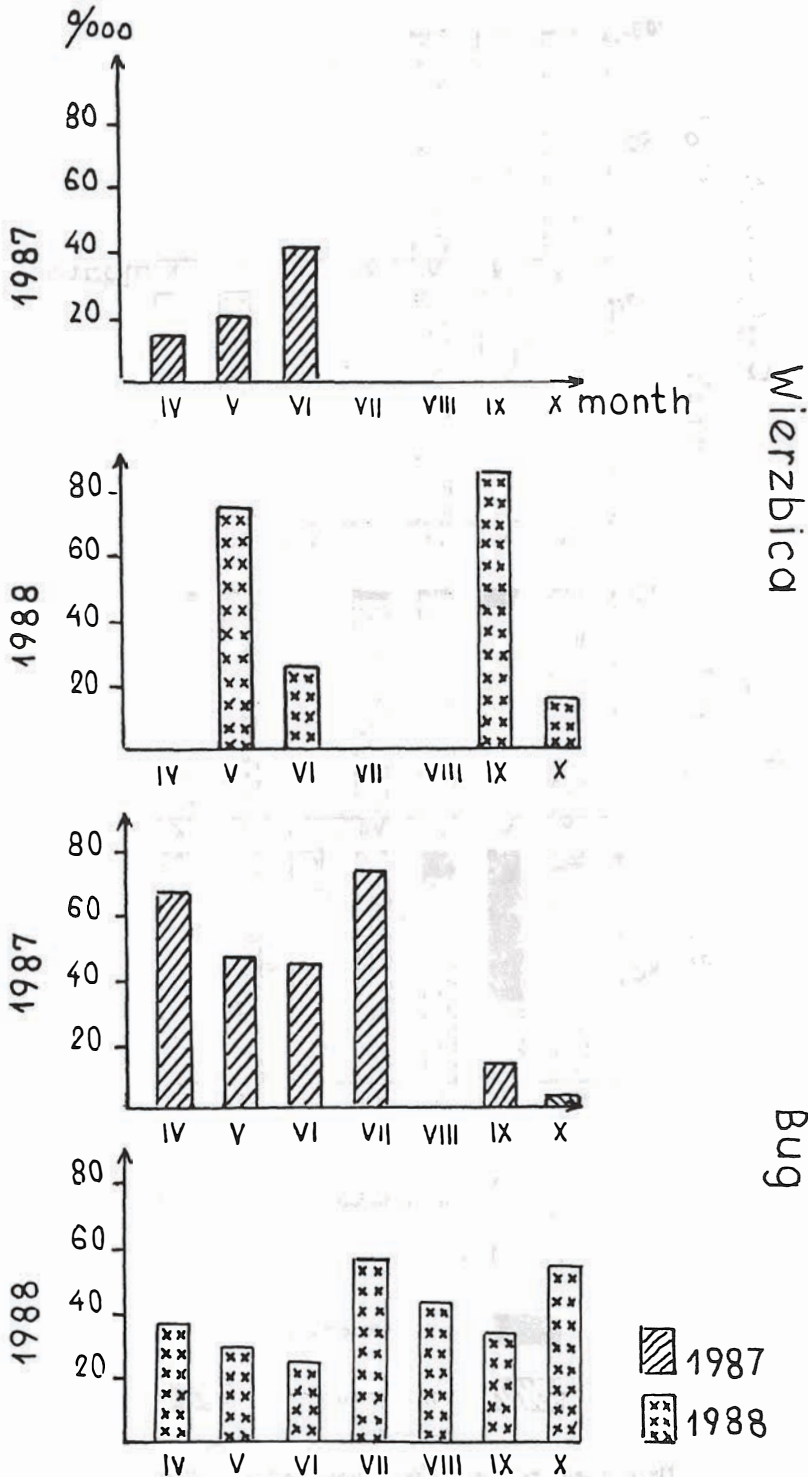


Fig. 5. Index of fullness of white bream food tracts

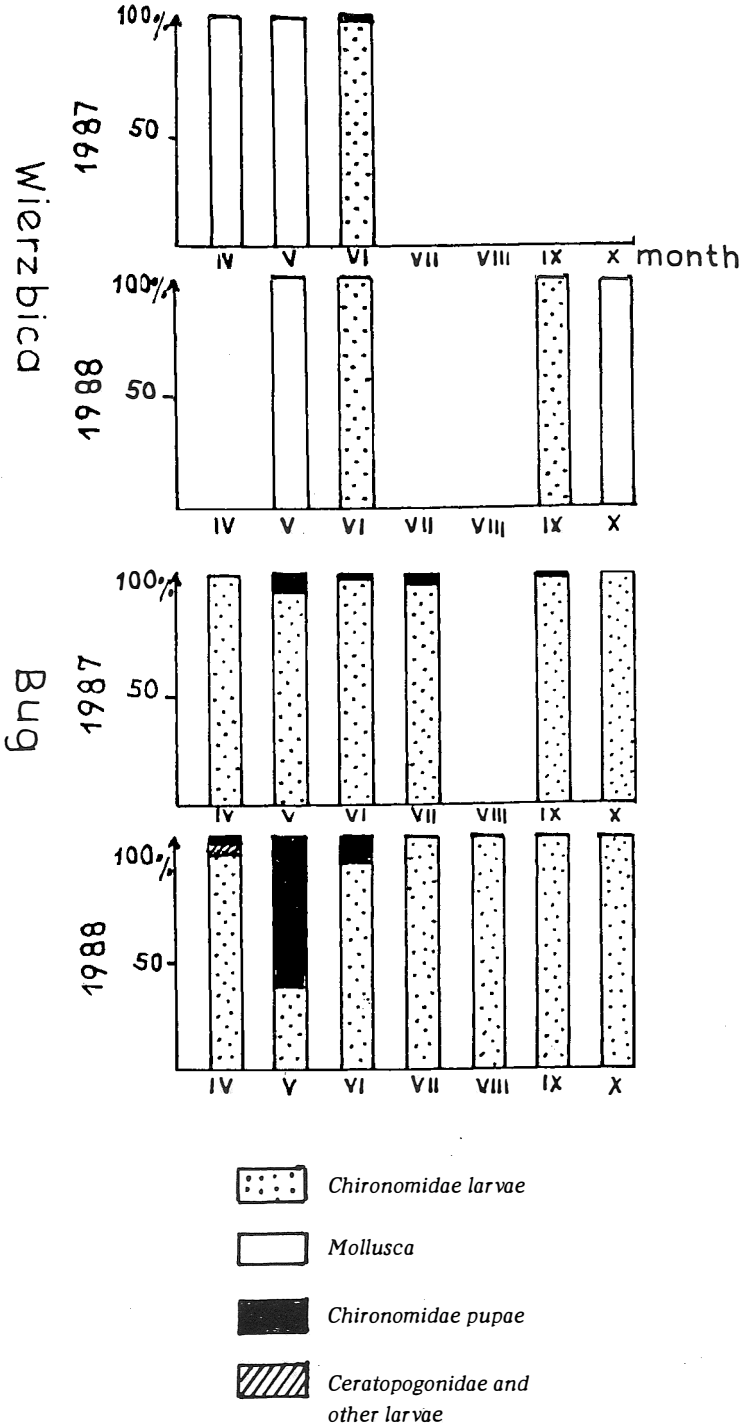


Fig. 6. Weight percentage of food components of white bream



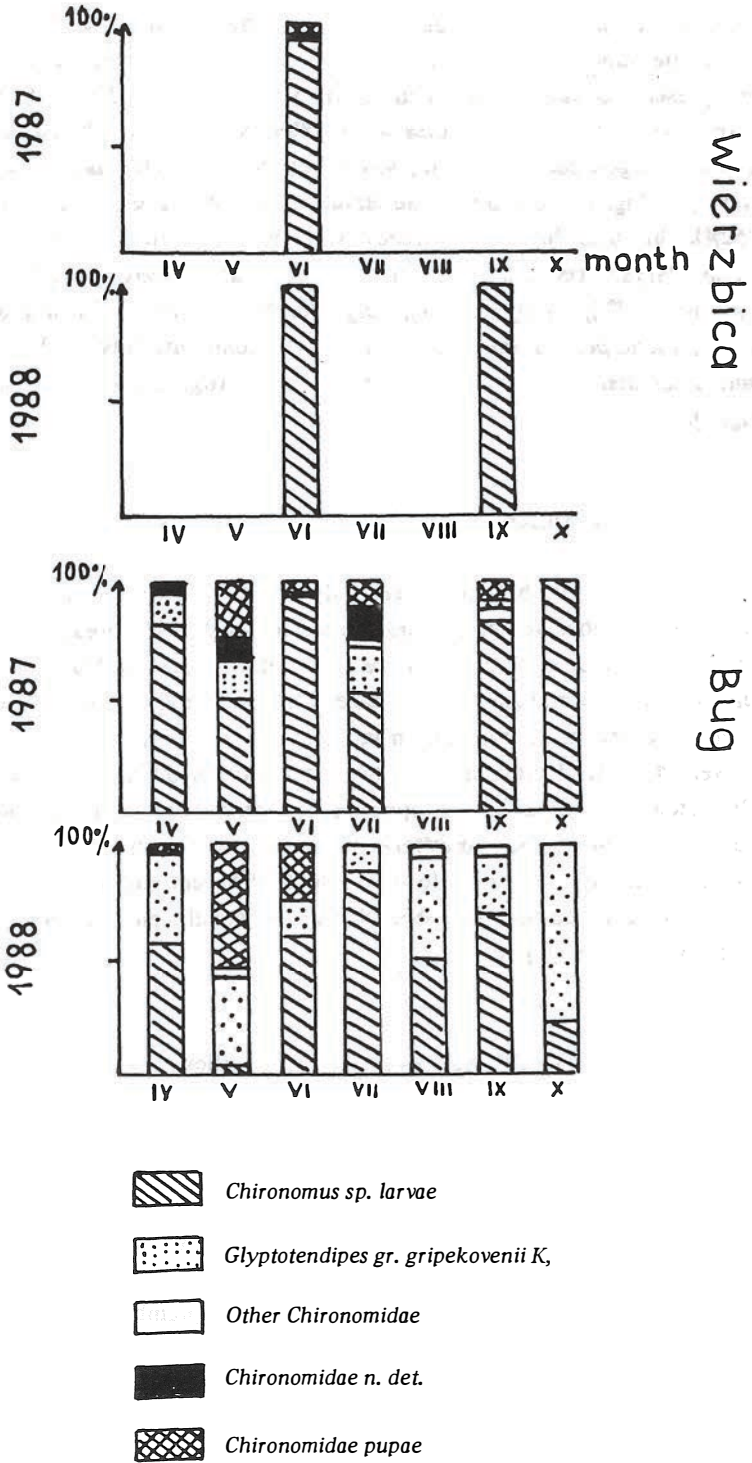


Fig. 7. Number percentage of food components of white bream

(22% of the numbers). *Chironomidae* pupae were the dominant (22.9%) only once, in May, and the subdominant in July (10.5%). Larvae of unidentified *Chironomidae* were present as subdominants in April (6.5%), May (9.2%) and July (15%) (Fig. 7). In 1988 white bream samples were collected in all months since April till October. *Ceratopogonidae* larvae appeared only once in April as sporadic components (over 1%) (Fig. 6). *Chironomidae* larvae were present as an eudominant only in May (52%). In June they were already a dominant (23%). In the other months *Chironomidae* larvae predominated, *Chironomus sp.* larvae were present as an eudominant in April (57%), June (60.3%), July (90.3%), August (53%) and September (72.4%). *Glyptotendipes* larvae were present as eudominant only in October (77%), but became a dominant in April (41.5%), May (43%), August (46.3%) and September (27%) (Fig. 7).

### III. Differences in the diet of the two species

Diet of bream and white bream differed only at two stations: Wierzbica and Bug. The differences were observed on the first station in April 1987. Bream diet consisted mostly of *Chironomidae* larvae and white bream of molluscs. In May 1987 and 1988 bream consumed mostly molluscs, while share of *Chironomidae* larvae was small. At the same time bream at this station fed on molluscs only. In September 1988 *Mollusca* were the main food component of bream and *Chironomidae* larvae of white bream. In October the situation was opposite i.e. bream fed on *Chironomidae* larvae and white bream on molluscs. No differences were observed in 1987 on station Bug. *Chironomidae* larvae were the main food item both of bream and white bream. Some differences were observed in May 1988. Bream fed mostly on *Chironomidae* larvae and white bream on their pupae.

### IV. Differences between the stations

Bottom was covered with a layer of mud on all stations. It was most thick on station Bug. Most shells (up to 30 thousand ind. per m<sup>2</sup>) were observed in 1987 at the River Bug mouth (Dusoge 1990). However, *Mollusca* were most frequently consumed on station Wierzbica. In April and May 1987, and in May and October 1988 they represented 100% of the food consumed by white bream. Bream from this station consumed molluscs mostly in May 1987 and in May and September 1988. *Chironomidae* larvae and pupae were the main food item of both bream and white bream from stations Bug and Zegrze.

Table 4

Comparison of numbers of selected benthos taxons (Kuklińska 1989)  
with their numbers in the diet of bream and white bream  
in Zegrzyński Reservoir

Taxon	Station							
	Wierzbica			Bug			Zegrze	
	<i>Abramis brama</i>	<i>Blicca bjoerkna</i>	bottom	A.b.	B.b.	bottom	A.b.	bottom
<i>Chironomus sp.</i>	++++	++++	+++	++++	++++	+++	++++	++
<i>Glyptotendipes gr. gripekovenii K.</i>	++++		+++	+++	++++	+++	++	+++
<i>Procladius sp.</i>	++		+++	+	+	++	++	++
<i>Cryptochironomus sp.</i>	+	+	++	+	+	++	+	++
<i>Endochironomus gr. tendens Fabr.</i>	+		+		+	+		+
<i>Polypedilum sp.</i>	+		++			++		++
<i>Stictochironomus sp.</i>			++		+	+	+	+++

++++ &gt; 30%

+++ 5 - 30%

++ 1 - 5% of total numbers

+ &lt; 1%

A.b. - *Abramis brama* L.B.b. - *Blicca bjoerkna* L.

Table 4 presents the most frequent food items of bream and white bream diet and their presence in the reservoir (Kuklińska 1989). Food of the two species contained more *Chironomus sp.* larvae than their percentage in the bottom fauna. *Glyptotendipes sp.* larvae were more frequent in bream diet on the station Wierzbica than in the bottom fauna. White bream from station Bug consumed more *Glyptotendipes sp.* larvae that would result from the studies on bottom fauna (Kuklińska 1989). The other taxa were less frequent in the diet of the two species than in the bottom fauna.

## DISCUSSION

Mature bream feeds mostly on invertebrate fauna (Prejs 1973, Wielgosz a. al. Tadjewska 1988). *Gastropoda*, *Bivalvia*, *Crustacea* and *Insecta* are the main food components (Rask 1989, Stolarov 1985, Lammens a. al., 1987). From among these *Chironomidae* larvae are decisively the most important. (Žiteneva 1960, Zadorožnaja 1977, Martyniak a. al. 1987). The same was observed in Zegrzyński Dam Reservoir. *Chironomidae* larvae were the main food items in bream and white bream diet. Numbers and biomass of bottom fauna in this reservoir reached very high values. Molluscs predominated – they constituted 93% of the total biomass of bottom fauna in the reservoir. However, it should be noted that shells represent 50% of mollusc biomass, while digestible parts only 46.5%. Apart from the molluscs, bottom fauna contained large numbers of *Chironomidae*. They represented 35% of the whole production biomass (Kajak 1990 a). High numbers were also reached by *Oligochaeta*, but they were mostly juvenile forms so their biomass was not very high. As regards *Chironomidae*, *Chironomus sp.* larvae attained considerable size (up to 25 mm) so their biomass was also high. This was the reason for high *Chironomidae* biomass (Dusoge a. al. 1990). As results from the studies on zoobenthos (Kuklińska 1989) stations Wierzbica was characterized by the lowest numbers and biomass of Mollusca and of the so-called "soft benthos". Intermediate values were observed on station Zegrze. The highest numbers and biomass of Mollusca, *Oligochaeta* and *Chironomidae* were noted on station Bug. This station was the most fertile. Biomass of *Chironomidae* larvae reached 349 gm<sup>2</sup> in 1987 at the depth of 1 m. Since the larvae were present in high densities, they constituted the main food item in diet of bream and white bream. This station was also very rich in *Oligochaeta*, but the two fish did not penetrate deeper mud layers with *Oligochaeta* (Kuklińska 1989) due to the abundance of *Chironomidae* larvae. Even roach fed on *Chironomidae* larvae on this station despite the fact that it is a typical mollusc feeder. These larvae represented 13–72% of the content of roach food tracts (Szczyglińska 1991).

Data on the intensity of feeding are very diversified. For example it was estimated at 95%.. in Wołgogradzki Reservoir (Nebolsina 1962), 82%.. in Dalešič Reservoir (Adamek a. al. 1987), 23–126%.. in Mostišť Reservoir (Kokeš and Gajdušek 1978), and only 9 to 37%.. in Perzchały Reservoir (Martyniak a. al. 1987). In Zegrzyński Dam Reservoir it ranged from 5.6%.. to 85%.. .

Food is frequently determined by the composition of bottom fauna in the water body. An thus, mature bream from north lagoon of the Caspian Sea fed mostly on molluscs (*Dreissena polymorpha*), but *Dreissena* was very numerous there and represented 75% of the biomass of bottom fauna (Stolarov 1985). Molluscs were also the main food item of bream in Tvärminne, north part of the Baltic Sea (Rask 1989).

Different results were obtained by Lammens (1984) who studies bream diet in eutrophic lakes. When zooplankton was very abundant all size-classes of bream fed on zooplankton, but when its abundance decreased small bream (less than 20 cm) consumed benthic *Cladocera* while bigger fish – *Chironomidae* larvae. This author stated that the amount of food consumed depended on food abundance, size of food organisms and their availability. Želtenkova and Kogan (1985) stated that benthos can be grazed upon at 55–89% of its production. Hence, possibility of utilizing the food resources depends on the type of prey organisms and their density in a reservoir. Maximal densities of animals are always noted in deeper sediments (Gusar, Pjanov 1988). Eggers (1977) and Žiteneva (1983) proved that total consumption and diet composition depended on prey densities.

When there no bottom fauna available bream consumes zooplankton (Zadorožnaja, Sappo 1974). Planktonic crustaceans (*Daphnidae*) constituted the main component in the diet of mature bream from Lake Tjeukemeer in Denmark (Lammens et al. 1985). This food was sufficient to ensure good fish condition.

*Oligochaeta* were always estimated as less frequent in feeding studies because they do not possess shells, chytinous carapaces etc. Hence they can be completely digested within an hour after ingestion (Galinsky, Nikitin 1972). In Norwegian lakes *Oligochaeta* were the main food item in the diet of *Coregonidae* (Milbrink 1973 b). Considerable role played by *Oligochaeta* in the diet of benthic feeding fish was underlined by Mirošničenko (1978), Ermolin (1979) and Žiteneva (1982). When *Chironomidae* numbers decrease, *Oligochaeta* become quite important. In Kujbyzowski and Cymłański reservoirs *Oligochaeta* were of primary importance in the diet (Jegereva 1960, Žiteneva 1981).

In the recent years detailed studies were performed on the feeding of plankton-eating fish. Two methods of feeding were distinguished: filtration (Eggers 1977, Lammens 1985, Hoogenboezem et al. 1991) and individual feeding. In the case of filtration white bream is less effective than bream. This is due to the structure of gills (Hoogenboezem 1990). When prey organisms are small bream feeds more effectively than white bream. But when the food resources are composed of bigger organisms and the particles of consumed substrate are bigger, white bream is more efficient in filtering the food than bream (Lammens 1984). Detailed studies were also performed on mouth (Winfield et al. 1983) and the structure of filtering-gill apparatus (Hoogenboezem et al. 1990). Lammens et al. (1987) described differences in filtering process, pharyngeal teeth and mouth proportions between roach, bream and white bream which allowed these species to occupy different food niches in the same conditions in eutrophic Danish lakes. Bream is able to penetrate deeper into the bottom sediments because its mouth is more protruding. This fact was observed by Brabrand (1984) when he compared bream with white bream. Roach is the only fish with pharyngeal teeth strong enough to crush mollusc shells (Rask 1989).

Distribution of resources in a water body is a commonly known phenomenon. It is thought that it is a feature of species coexistence. Distribution of the resources differs depending on utilizing abilities of the coexisting species. Studies showed that overlapping of the diets was very unstable. In the cycles rich in food overlapping was considerable, in poor cycles it was minimal. Lammens et al. (1985) showed that when food resources were abundant and fish were in good condition diets did overlap. When condition deteriorated and food resources decreased there was a change of the food niche and fish diets did not overlap.

It seems that in Zegrzyński Reservoir bream and white bream are coexisting rather than competing.

### CONCLUSIONS

1. *Chironomidae* larvae and molluscs were the main food item on station Wierzbica, Mollusca were present as eudominants in bream diet in May and September, and in white bream diet in April, May and October.
2. *Chironomidae* larvae were the main food item on station Bug. Only in May 1988 *Chironomidae* pupae were present as an eudominant in white bream diet.
3. *Chironomidae* larvae were the main food item in bream diet on station Zegrze.

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POKARM LESZCZA *ABRAMIS BRAMA* (L.) I KRĄPIA *BLICCA BJOERKNA* (L.)  
W ZBIORNIKU ZEGRZYŃSKIM

## STRESZCZENIE

W 1987 i 1988 roku badano zawartość przewodów pokarmowych leszcza i krąpia ze Zbiornika Zegrzyńskiego. Przeanalizowano 636 przewodów pokarmowych leszcza i 537 krąpia. Próby pobierano na trzech stanowiskach: Wierzbica, Bug i Zegrze. Głównym składnikiem pokarmu były *Chironomidae* (larwy i poczwarki) oraz *Mollusca*. Dominowały larwy *Chironomus* sp. i *Glyptotendipes* sp. Na stanowiskach Bug i Zegrze larwy *Chironomidae* były głównym składnikiem obu badanych ryb. Najwięcej *Mollusca* zaobserwowano w pokarmie na stanowisku Wierzbica. Różnice w składzie pokarmu między gatunkami wystąpiły na stanowiskach Wierzbica i Bug.

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