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Research Article

AN ATTEMPT TO DETERMINE THE SHARE OF ZOOPLANKTON IN FOOD CONSUMED BY FISH IN THE LIMNETIC ZONE OF A EUTROPHIC DAM RESERVOIR

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Abstract

Zooplankton was the only food component of common bream and silver bream, and the main food component of roach and bleak in the pelagic zone of the Dobczyce Reservoir (southern Poland) from April to October 1994. Cladocera and Copepoda constituted 67.9% of the food consumed by the whole fish community. The average size of eaten individuals ranged from 0.62 to 1.43 mm. Planktivorous fishes selected phytoplankton-controlling filtrators, mainly large *Daphnia* species, which were eliminated most effectively in the summer.

INTRODUCTION

The Dobczyce Reservoir was built in 1986 for the municipal water supply for Cracow. This is why maintaining the good quality of the stored water is very important. The impact planktivorous fish have on water quality as a result of grazing planktonic crustaceans was presented in many articles concerning mainly lakes (Hansson *et al*. 1987, Horppila and Kairesalo 1990, 1992, Horppila 1994, Reynolds 1994). The pressure of fish on zooplankton is directed in particular towards large cladocerans of the *Daphnia* genus, which can control algal density (reviewed in Dawidowicz and Gliwicz 1987, Reynolds 1994). This led to the belief that water quality could be improved by changing the trophic structure of the biocenosis through the manipulation of the composition of the fish community (Adámek 2000). The relations between planktivorous fish and zooplankton species, which control the density of algae, seem to be especially interesting in eutrophic ecosystems.

The aims of the present study were to (1) investigate the trophic structure of the community of the limnetic zone in a eutrophic reservoir, (2) estimate the fraction of planktonic crustaceans eliminated by fish and (3) determine which fish species can influence zooplankton in a significant way.

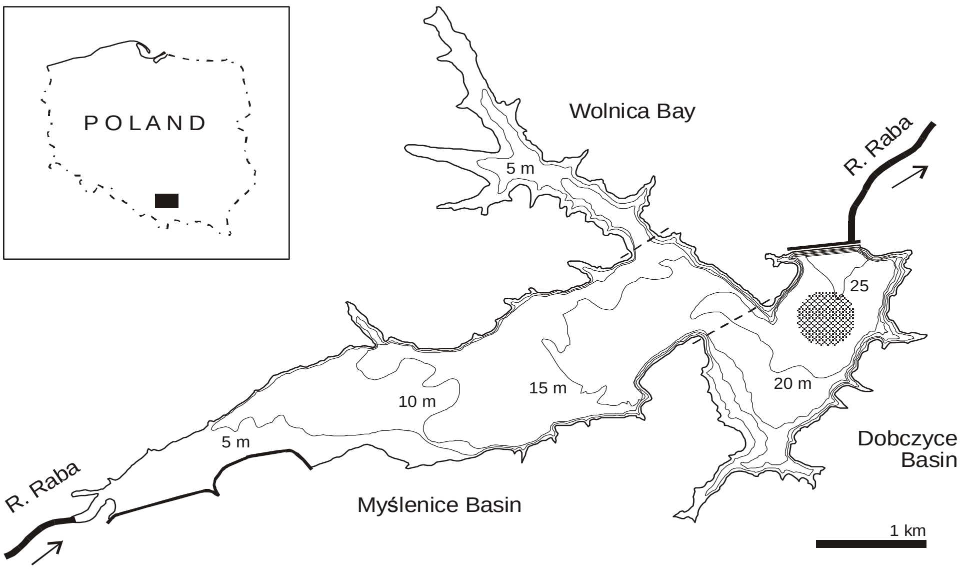

Fig. 1. The Dobczyce Reservoir (dashed lines indicate the boundaries of the three main parts of the reservoir). Cross-hatched circle indicates the location of the sampling area.

STUDY AREA

The dam of the Dobczyce Reservoir (49^o 52' N, 20^o 02' E) is situated on the 60th km of the course of the Raba River in the Vistula Basin. It is about 30 km south of Cracow between the towns of Dobczyce and Myślenice in the region of the Pogórze Wielickie hills of the Carpathian Mountains. At the standard damming level (269.9 m above sea level) the surface area is 985 ha, volume is 108 10^6 m^3, mean depth is 11 m and the maximum depth is about 27 m

(Amirowicz 1998) (Fig. 1). The water level can fluctuate within the range of 256.7 to 272.6 m, which corresponds to changes in area from 387 to 1112 ha and in volume from 18.3 to 137 10^6 m^3. The catchment basin area is 763 km^2 (Pasternak 1980). The main tributary of the reservoir is the Raba River which supplies 88.6% of the total inflow (Mazurkiewicz 1988). At an annual, average discharge of about 10 m^3 s^{-1} (Punzet 1969), the flushing rate is equal to about 2.9 yr^{-1}. The reservoir is dimictic and is stratified between May and September (Amirowicz 2000).

In 1994, the average water temperature in the surface layer (0–5 m) near the dam (the Dobczyce Basin) ranged from 2.3 (February) to 25.1 °C (August), while oxygen saturation ranged from 57% (October) to 98% (February, May). The concentration of mineral phosphorus in the epilimnion reached 0.136 mg dm^{-3} and nitrate nitrogen ranged from 0.464 (October) to 1.825 mg dm^{-3} (May). In spite of this, planktonic algae developed richly from spring to autumn, which caused a decrease of the Secchi depth from 3.2 to 1.2 m and an increase of pH from 7.61 to 9.17 (Mazurkiewicz-Boroń 2000).

In 1994, diatoms (in spring) and cyanobacteria (in summer and autumn) predominated the phytoplankton biomass. Brief appearances of green algae, cryptophytes and dinophytes were also recorded from spring to autumn. From April to October the threshold of a 50% share in the biomass of the phytoplankton community was exceeded by *Cyclotella* spp., *Cryptomonas* sp., *Ceratium hirundinella* (F.B. Müller) Bergh, *Microcystis aeruginosa* Kütz., *Synedra* sp. and *Woronichinia naegeliana* (Unger) Elenkin. Two peaks (May and September) appeared in the development of phytoplankton when the maximum of chlorophyll *a* concentration exceeded 30 mg dm^{-3}. The lowest amounts of algae were observed in the winter (February and March) when the chlorophyll *a* content was below 3 mg dm^{-3} (Wilk-Woźniak 2000).

Twenty-four species were noted in the zooplankton community - 12 rotifers, 7 copepods and 5 cladocerans. From April to October the dominant species were *Keratella cochlearis* Gosse, *K. quadrata* Müller, *Polyarthra vulgaris* Carlin (rotifers), *Cyclops strenuus* Fischer (copepods), *Daphnia cucullata* Sars and *D. longispina* O.F. Müller (cladocerans). The density of zooplankton ranged from 50 to 1050 ind. dm^{-3} with rotifers dominating (up to 800 ind. dm^{-3}). The total biomass (dry weight) ranged from 0.40 to 1.45 mg dm^{-3}. The main dominants were copepods – from May to August their dry weight reached values >1 mg dm^{-3}. The density of cladocerans ranged between 2–114 ind. dm^{-3} and their dry weight was between 0.016–0.404 mg dm^{-3}.

Thermal stratification in the Dobczyce Basin (with the thermocline between 8–12 m) lasted from spring to autumn 1994. During this period, the oxygen concentration in the hypolimnion decreased to <1 mg dm^{-3}, which excluded the permanent occurrence of fish. The fish community in the epilimnion consisted of ten species: common bream *Abramis brama* (L.); roach *Rutilus rutilus* (L.); silver bream *Blicca bjoerkna* (L.); bleak *Alburnus alburnus* (L.); chub *Leuciscus cephalus* (L.); silver carp *Hypophthalmichthys molitrix* (Val.); bighead *Aristichthys nobilis* (Rich.); perch *Perca fluviatilis* L.; pikeperch *Stizostedion lucioperca* (L.); lake trout *Salmo trutta* m. *lacustris* L. (Amirowicz *et al*. 2000).

MATERIAL AND METHODS

The composition of the zooplankton and fish community in the limnetic zone of the reservoir was investigated in the central part of the Dobczyce Basin (Fig. 1) from April to October, 1994. Zooplankton was collected using a 5-L sampler at depths of 0, 2, 4, 6, 8, 10, 15 and 20 m. The samples were concentrated with a plankton net (mesh 50 μm) and preserved with 4% formaldehyde. The composition of planktonic crustaceans was studied under a binocular microscope (magnification 10–20x) in a 0.5 cm^3 chamber. One hundred of the first specimens found were recorded and measured. The dry weight was assessed according to published regression formulae and equations (Cummins *et al*. 1969, Dumont *et al*. 1975, Bottrell *et al*. 1976, Ruttner-Kolisko 1977, Persson and Ekbohm 1980).

The fish were collected in the central part of the Dobczyce Basin once a month using a set of gill nets (10–70 mm mesh size). This sampling gear, which consisted of seven nets with fixed linear differences in mesh size, reduced the effect of selectivity of particular gill nets. Therefore, the qualitative and quantitative data obtained were regarded as sufficiently representative of the fish community as a whole. Although twelve fish species were recorded (bream, roach, silver bream, bleak, chub, nase *Chondrostoma nasus* (L.), rudd *Scardinius erythrophthalmus* (L.), silver carp, bighead, perch, pikeperch and lake trout), four of them were omitted from the study - nase and rudd because only single specimens were collected and their occurrence in pelagic zone should be regarded as accidental, and Chinese carp which were beyond the selection range of the fishing gear due to their large size (1 m length, >20 kg weight; this exotic species does not reproduce in the Dobczyce Reservoir because of the inappropriate thermal regime).

The relative abundance and biomass of each species were estimated in terms of the mean catch per unit of effort (CPUE). The 20-hour exposition of running meter of each gill net was assumed as the unit of fishing effort, so the CPUE was calculated as:

$$CPUE_N = \Sigma\, n_i / g_i$$
$$CPUE_B = \Sigma\, b_i / g_i$$

where: n_i – number of individuals caught with i-th gill net (ind.), b_i – sum of body weights of caught individuals (g), g_i – length of i-th gill net (m).

Evidence of fish diet composition was compiled from stomach contents (or the foregut in cyprinids) which had been preserved in alcohol. The recorded food items were divided into four categories - zooplankton, benthic food (macroinvertebrates, filamentous algae and detritus), surface food (insects from the water surface) and fish. The composition of the planktonic crustaceans eaten was estimated based on the first one hundred specimens recorded and measured. They were identified to the taxonomic level depending on the degree of digestion under a binocular microscope (magnification 10–20x). The significance of differences between the composition of the planktivorous fish food and the zooplankton community was tested with the paired Wilcoxon test (Sokal and Rohlf 1987). The relative importance of each food category was assessed by estimating the volume and expressing it as a percentage of the total sample volume. The average diet composition was calculated for each species and sampling date.

According to Eggers (1979), the weight of food consumed by a fish over a period of time may be calculated as:

$$W_C = \Delta t\, W_S\, k$$

where: W_C – consumed food (g), Δt – time period (h), W_S – mean weight of stomach content (g), k – evacuation rate (h^{-1}). Therefore, it was assumed that the weight of the stomach or foregut content is proportional to body weight. The factor of this proportion, as well as the evacuation rate, were assumed to be constant in all the investigated species for two reasons - (1) all of them are carnivores and (2) the energy and nutrient requirements in relation to a unit of body weight and time in all of them can be considered as similar. Accordingly, the amount of food consumed can be regarded as correctly proportional to the relative biomass of a species and can be estimated using $CPUE_B$.

Although the rate of food consumption is determined by a number of factors, only the effect of temperature was taken into consideration in this study. It was assumed that in eutrophic conditions and during the warm season the other abiotic factors and the availability of food did not significantly affect foraging activity. According to van't Hoff's rule, the velocity of chemical reactions increases at a constant rate for each rise of 10°C in temperature.

Therefore, the effect of this factor can be estimated using the temperature coefficient (Q_{10}), *i.e*. a number indicating the effect of temperature change on metabolic processes:

$$Q_{10} = (R_E / R_R)^{\wedge}(10/(T_E - T_R))$$

where: R_E, R_R – the estimated and reference rate of metabolism, respectively, T_E, T_R – temperatures respective to R_E and R_R. Assuming that Q_{10}=2, T_R=10 °C, and at the reference temperature R_R=1 the relative rate of metabolism was estimated as:

$$R_E = 2^{\wedge}(T_E/10 - 1)$$

This standardized metabolic rate was used to adjust the relative ration estimates (W_E) to water temperatures recorded on particular sampling dates:

$$W_E = R_E\ CPUE_B$$

The products were averaged by weighting them by lengths of periods between subsequent dates and were expressed as percentages of the total amount of food consumed by the fish community throughout the study period.

RESULTS AND DISCUSSION

Three species dominated the fish community in the limnetic zone of the Dobczyce Basin in 1994 - roach, bream and bleak, which constituted 95% of the total density (Table 1, Fig. 2). Zooplankton organisms were found in the food of common bream (100% of the total volume of food items), silver bream (100%), roach (0–92%) and bleak (2–100%) (Table 2). Fish collected in the pelagic zone also ate food items from three categories other than zooplankton, *i.e*. benthic food, surface food and fish. The presence of benthic organisms was recorded exclusively in the diet of roach. This might be explained only by horizontal migrations in diel cycles because the bottom in the profundal is inaccessible to fish in summer due to the deoxygenation of this water layer. The main food category of the pelagic fish community was zooplankton, which was about two-thirds of the total amount of food eaten (Fig. 3). Zooplanktivorous species constituted 91.5% of the total fish biomass. This is evidence that the majority of the fish community participates in the pelagic food chain. It is noteworthy, however, that considerable portions of foraged biomass are imported to the limnetic zone from nearby terrestrial habitats as imagines fall onto the water surface or are transferred from the littoral as benthic food items (about one-tenth and one-sixth of the total fish food, respectively).

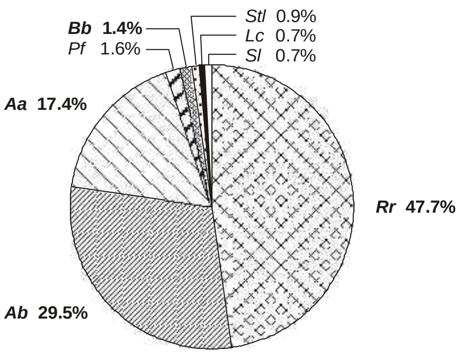

Fig. 2. The structure of fish community in limnetic zone of the Dobczyce Reservoir in the period April–October 1994.
Aa – bleak, *Alburnus alburnus* (L.), *Ab* – common bream, *Abramis brama* (L.), *Bb* – silver bream, *Blicca bjoerkna* (L.), *Lc* – chub, *Leuciscus cephalus* (L.), *Pf* – perch, *Perca fluviatilis* L., *Rr* – roach, *Rutilus rutilus* (L.), *Sl* – pikeperch, *Stizostedion lucioperca* (L.), *Stl* – lake trout, *Salmo trutta* m. *lacustris* L. Presented values are calculated on the basis of weighed means of CPUE (catch per unit of effort, details explained in the text). Planktivorous species are bolded.

Crustaceans belonging to Cladocera (*Bosmina longirostris* O.F. Müller, *Daphnia cucullata*, *D. longispina*, *Leptodora kindtii* Focke) and Copepoda (*Cyclops strenuus*, and unidentified immature forms - nauplii and copepodites) occurred in the food of planktivorous fishes. Due to the high degree of maceration of the prey, it was often impossible to determine the genera or species. The size of prey in the zooplankton community was as follows: *D. longispina* 0.62–1.75 mm; *D. cucullata* 0.58–1.30 mm; *B. longirostris* 0.22–1.00 mm; *L. kindtii* 2.16–6.39 mm; nauplii 0.11–0.39 mm; copepodites 0.41–1.24 mm. Fish species preferred relatively large prey (Fig. 4), and the size of the eaten prey was in the following ranges: *Bosmina* sp.- 0.39–0.73 mm; *Daphnia* sp. - 0.73–1.75 mm; *L. kindtii* - 2.16–6.39 mm; nauplii - 0.2–0.3 mm; copepodites - 0.43–1.03 mm; adult copepod forms - 0.95–1.75 mm.

Laboratory studies showed that *Cyclops vicinus* Ulianine, commonly considered a predator, and other Cyclopoida, especially younger stages, can eat small flagellates, *e.g*. *Chlamydomonas reinhardtii* Dang. (Santer 1993, Santer *et al*.1994). It cannot be ruled out that these copepods participate in the elimination of phytoplankton since algae within the size range of *Chlamydomonas* are present in the phytoplankton of the Dobczyce Reservoir. Instead, the only large macrofiltrator in the reservoir is *Eudiaptomus gracilis* G.O. Sars (a calanoid). *E. gracilis* was not recorded in the diets of the fish although it was permanently present in the zooplankton community during the investigation period (average relative density 7%). One possible explanation could be that the food was so highly macerated that properly determining

Table 1

Fish species collected in the limnetic zone of the Dobczyce Reservoir in 1994 (*n*=626). For each part of the set of gill nets the numbers of caught individuals are given. The CPUE (catch per unit of effort) computation procedure is explained in the text.

Species	Gill nets							$CPUE_N$
Mesh size (mm) Length (m)	10 7.7	20 8.2	30 16.9	40 41.4	50 41.1	60 41.3	70 42.0	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Rutilus rutilus (L.)								
6 April			2					0,118
17 May		1	47					2,903
14 June		4	21		1			1,755
13 July		6	56					4,045
9 August		3	50	1				3,349
20 September	1	2	17					1,380
Abramis brama (L.)								
6 April			1	33	9			1,075
17 May			9	155	16	1		4,690
14 June			1	4	7			0,326
13 July				29	4			0,798
9 August			1	47	9			1,413
20 September				1				0,024
19 October				3	1			0,097
Alburnus alburnus (L.)								
6 April		6						0,732
17 May		3						0,366
14 June		2						0,244
13 July		8						0,976
9 August		18						2,195
20 September		2						0,244
19 October		6						0,732
Blicca bjoerkna								
6 April			3					0,178
17 May			1					0,059
14 June			3					0,178
13 July			1					0,059
Leuciscus cephalus (L.)								
6 April			1					0,059
17 May			1					0,059
20 September			1					0,059
19 October				3		1		0,097

1	2	3	4	5	6	7	8	9
Perca fluviatilis L.								
17 May				1				0,024
14 June					2			0,049
13 July		2	1					0,303
9 August			2					0,118
Stizostedion lucioperca (L.)								
6 April			1					0,059
13 July				2				0,048
9 August			1		2			0,108
Salmo trutta m. *lacustris* L.								
17 May		1						0,122
14 June		1						0,122
19 October				1				0,024

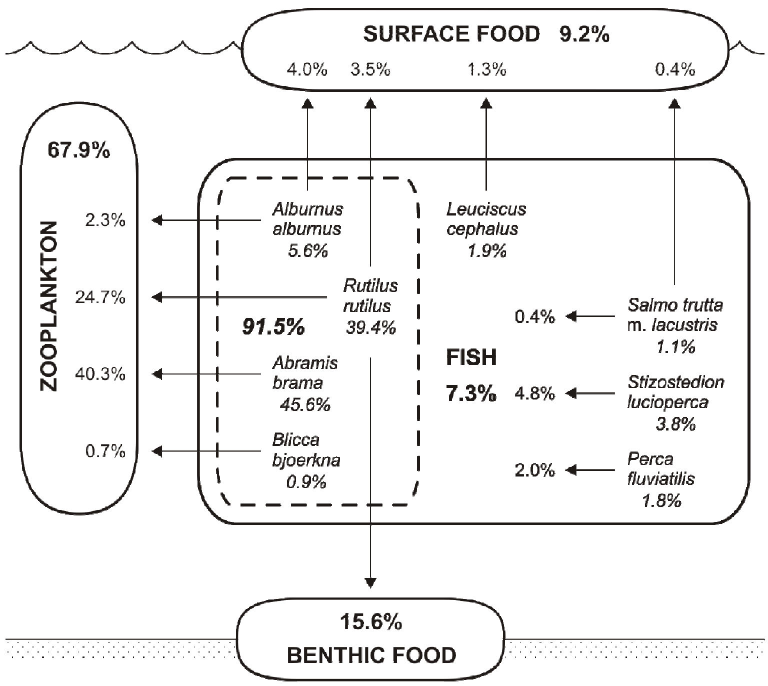

Fig. 3. The scheme of trophic relations of fish community in limnetic zone of the Dobczyce Reservoir in the period April–October 1994. The relative biomasses of each species (estimated on the basis of weighed means of catch per unit of effort, details explained in the text) are given with italics, while relative shares of its food categories with normal style. Planktivorous species are placed in dashed block.

Table 2

The relative biomass (expressed as the catch per unit of effort - CPUE) and the diet composition (%) of the fish community in the limnetic zone of the Dobczyce Reservoir in 1994 (*n*=626). The procedures for computing the CPUE and temperature correction factor are explained in the text.

Species	Sampling dates						
	6 Apr	17 May	14 June	13 July	9 Aug	20 Sep	19 Oct
Water temperature[a] (°C)	5.1	13.8	16.7	22.9	22.6	18.4	12.3
Temperature correction factor	0.71	1.30	1.59	2.45	2.39	1.79	1.17
Rutilus rutilus (L.)							
$CPUE_B$	15.15	336.99	193.34	499.07	418.12	152.99	
Zooplankton		78.3	90.6	5.3	91.6	47.6	
Surface food		20.4	9.4	5.2	7.0	0.7	
Benthic food	100	1.3		89.5	1.4	51.7	
Abramis brama (L.)							
$CPUE_B$	238.02	987.56	78.99	201.88	345.86	6.96	26.47
Zooplankton	100	100	100	100	100	100	100
Alburnus alburnus (L.)							
$CPUE_B$	37.2	17.07	9.51	48.17	101.95	10.37	31.71
Zooplankton	85.9	15.0	65.0	2.1	45.0	6.0	100
Surface food	14.1	85.0	35.0	97.9	55.0	94.0	
Blicca bjoerkna							
$CPUE_B$	15.03	7.75	14.62	5.33			
Zooplankton	100	100	100	100			
Leuciscus cephalus (L.)							
$CPUE_B$	12.78	12.96				12.43	93.51
Surface food	100	100				100	100
Perca fluviatilis L.							
$CPUE_B$		7.49	22.26	24.4	21.42		
Fish		100	100	100	100		
Stizostedion lucioperca (L.)							
$CPUE_B$	11.95			35.12	106.28		
Fish	100			100	100		
Salmo trutta m. *Lacustris* L.							
$CPUE_B$		8.78	21.59				32.34
Surface food		100	50.0				
Fish			50.0				100

[a] mean value within the 0–5 m depth range (G. Mazurkiewicz-Boroń. unpubl. data)

E. gracilis individuals was precluded. It is worth noting that rotifers were absent in the diet of planktivorous fish; this was in spite of the occurrence in the zooplankton of rotifer species with comparable sizes to those of consumed copepods and cladocerans. The avoidance of large *Asplanchna* species by roach was noted in enclosure experiments (Hessen 1985) in which roach aged 2+ (LT 6–8 cm) did not eat *Asplanchna priodonta* Gosse although it did eat the smallest sized *Bosmina longirostris*. This was related to differences in the pigmentation of these species. The significance of prey size and visibility was emphasized in other studies (Brooks and Dodson 1965, Raven and Mally 1986, Hessen and Nilssen 1986). The elimination of large individuals observed in the Dobczyce Reservoir concurs with results obtained in other eutrophic reservoirs (Arcifa 1986, Coen Van den Berg *et. al* 1994, Amirowicz *et al*. 2000, Pociecha 2002).

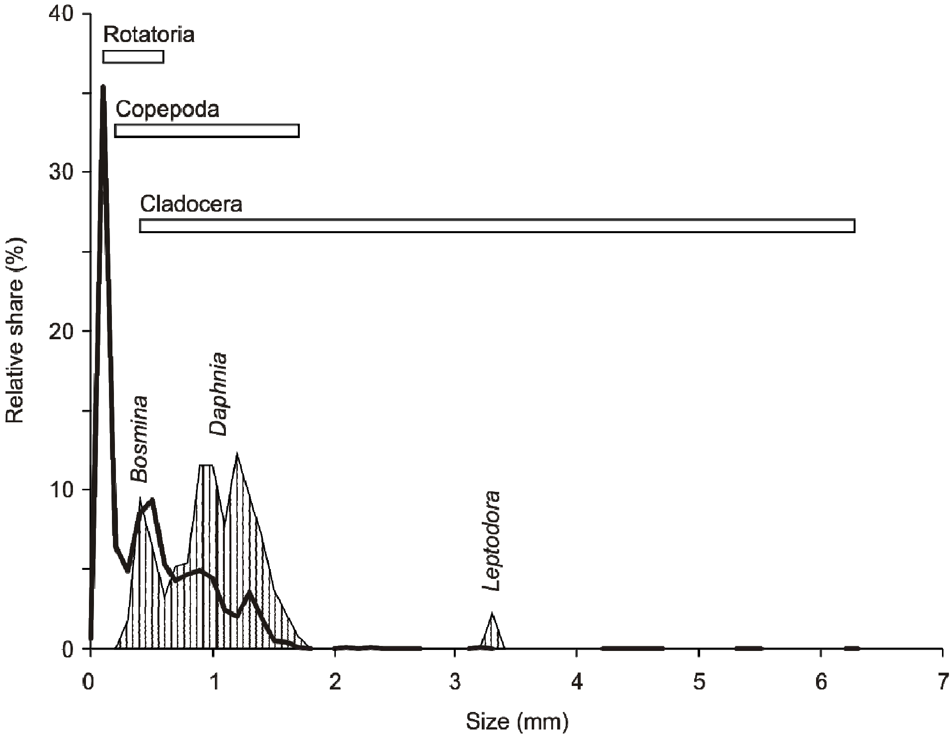

Fig. 4. Size distribution of individuals in zooplankton (line) and in fish diet (vertical hatching) in the pelagic zone of the Dobczyce Reservoir (April - October 1994). Horizontal bars indicate the size ranges of the recorded species of the main zooplankton groups.

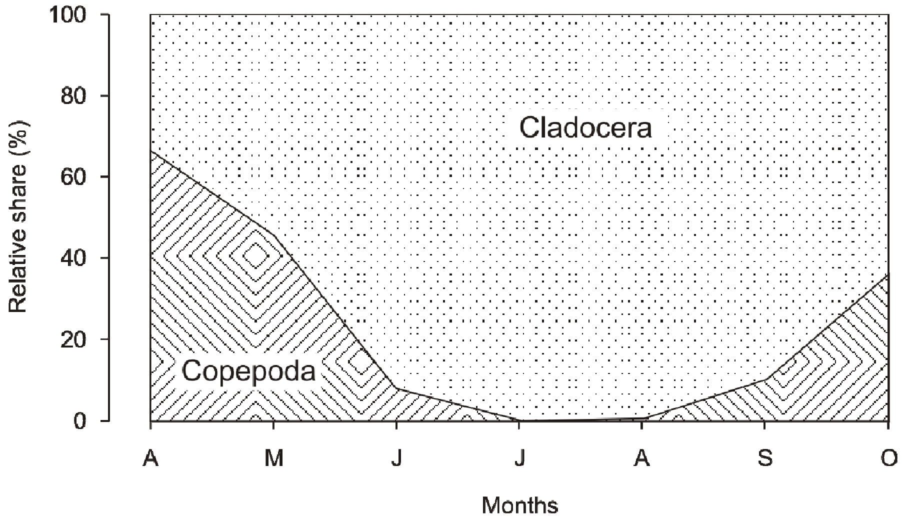

Fig. 5. Seasonal changes in the relative share of Copepoda and Cladocera in the diets of planktivorous fish in the pelagic zone of the Dobczyce Reservoir from April to October 1994.

Distinct seasonal changes in the share of each group of zooplankton were found. In May only Copepoda appeared in the diet of common bream. Species of *Daphnia* and *Bosmina* dominated in the remaining months. *Daphnia* and *Bosmina* species were also dominant in the food of roach. In the diet of bleak, *Daphnia* was the most preferred food throughout the study period. In general, fish eliminated cladocerans most effectively in summer. In comparison to their participation in the zooplankton community, cladocerans were eaten the most in August when the fish metabolic rate was two to three times greater than in spring and autumn, and the least in April and October (Fig. 5). Planktivorous fish selected prey in the following size ranges: 0.40–1.56 mm (common bream); 0.42–1.50 mm (roach); 0.39–1.40 mm (bleak); 0.46–1.60 mm (silver bream). The main consumers of the crustacean filtrators were roach and bream, and the main components of the fish diet were cladocerans (76%) and copepods (24%).

The results obtained indicate that planktivorous fish have a more pronounced preference for large *Daphnia* species (Table 3). The statistical analysis of the contribution of cladocerans in fish diet and in zooplankton (in terms of dry weight and density) demonstrated that this difference is significant ($P<0.005$) with relatively large *Daphnia* species, but not significant with small *Bosmina* species. Additionally, the analysis showed that the difference in the percentage share of filtrators in the zooplankton community and fish food is significant ($P<0.005$). The preferences demonstrated by planktivorous fish can modify the zooplankton composition, and this selectivity can lead to the reduction of large *Daphnia* and phytoplankton-controlling filtrators on the whole. The strongest impact on these fractions of zooplankton takes place in summer, and it could be an important factor in determining the composition of the zooplankton community in the Dobczyce Reservoir.

Table 3

Contribution of dominant Cladocera (%) in zooplankton and in planktivorous fish diet in the pelagic zone of the Dobczyce Reservoir (from April to October 1994).

	Density		Dry weight	
	Bosmina sp.	*Daphnia* sp.	*Bosmina* sp.	*Daphnia* sp.
Zooplankton	3.3	11.8	3.2	16.3
Fish diet	5.3	68.2	1.9	64.1

The selection of the largest individuals is explained by the theory of optimum foraging (Pyke *et al*. 1977). The large organisms provide a greater portion of energy, therefore catching and eating this prey is energetically more profitable. The detection distance, *i.e*. the shortest distance at which a predator reacts to prey, also grows proportionally to the size of the prey (O'Brien 1979). Among species in European lakes, large cladoceran filtrators of the genera *Daphnia* (*e.g*. *D. hyalina* Leydig), *Bosmina* (*B. coregoni* Baird) and large carnivorous cladocerans (*L. kindtii*) are eaten most often, while copepods and small cladocerans (*D. cucullata*, *B. longirostris*) are rarely consumed (Lang and Lang 1986, Post and McQueen 1987). In the Dobczyce Reservoir the size range of selected prey organisms concurs with the published data. For example, Gliwicz and Prejs (1977) showed that in lakes in Poland prey size ranged between 0.3–0.6 mm for *Bosmina* and 0.8–1.4 mm for *Daphnia*. It was confirmed that large cladocerans are very susceptible to the pressure of planktivorous fish and can constitute an important component of zooplankton only when the fish biomass is low (<100 kg ha^{-1}) (Seda *et al*. 1989).

The results presented above refer only to the collected species and size classes of fish. The gill nets used allowed for the collection of individuals of a total length within a range of 7.1– 82.0 cm. Thus, it should be taken into consideration that the 0+ age class of all species, as well as the stocks of silver carp and bighead which occur in the limnetic zone of the Dobczyce Reservoir and which definitely feed on zooplankton, remained beyond estimation. Chinese carp was stocked in 1986, and their initial density of 18 ind. ha^{-1} decreased to about 10 ind. ha^{-1} in December 1987 (Starmach 1988). The current impact of these species on zooplankton is probably negligible, because they have been an important object of local fishery since the 1980s, so their density in 1994 was low (the natural spawning of these species is impossible in the Dobczyce Reservoir). Although the representation of the 0+ cohorts in the limnetic fish community cannot be estimated accurately in this study, undoubtedly their pressure on zooplankton is relatively high (Gliwicz and Jachner 1992).

The results obtained cannot be used to estimate either fish biomass (*i.e*. in g m^{-2}) or the absolute fish pressure on zooplankton (in g m^{-2} d^{-1}) in the Dobczyce Reservoir. In addition, the scheme of trophic relations presented in the paper is based on approximate, relative fish biomass and metabolic rates. Despite such generalization, the computation procedure used in this study is a useful method for the realistic approximation of the composition of food consumed by a fish community. Thus, it can be concluded that the importance of the zooplankton community for fish species foraging in the limnetic zone in the Dobczyce Reservoir was well documented. This permits the supposition that a reduction in the density of the populations of some fish, mainly common bream and roach, could result in a change of the structure of the zooplankton community and/or in an increase in its abundance. However, as the reservoir is a deep water body, owing to the morphology of the basin, the effect of removing planktivorous fish may be relatively weak (Jeppesen *et al*. 1990).

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