Arch. Pol. Fish.	Archives of Polish Fisheries	Vol. 10	Fasc. 2	221-231	2002

THE IMPORTANCE OF BENTHIC FAUNA IN THE DIET OF SMALL COMMON BREAM *ABRAMIS BRAMA* (L.), ROACH *RUTILUS RUTILUS* (L.), PIKEPERCH *SANDER LUCIOPERCA* (L.) AND RUFFE *GYMNOCEPHALUS CERNUUS* (L.) IN THE WŁOCŁAWEK RESERVOIR

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ABSTRACT. The food composition of small common bream, roach, pikeperch and ruffe was studied in the shore area of the Włocławek Reservoir between July and October 1999. Zoobenthos and pelagic Chironomidae pupae dominated. Rotifers, copepods and cladoceran pelagic zooplankton were almost not consumed at all. Common bream fed mainly on benthic cladoceran Chydoridae and Chironomidae larvae. Roach consumed vegetation, Chironomidae larvae and small molluscs Sphaeriidae. Ruffe ate Chironomidae larvae, and pikeperch ate fish and various developmental stages of Chironomidae. Pelophilous chironomid forms, mainly from the genus *Chironomus,* dominated among the consumed larvae. Due to its exceptional abundance, the benthic fauna in the Włocławek Reservoir is an attractive food source for fish, and it plays an important role in their diet from the earliest life stages onwards. The benthic fauna also provides good developmental conditions, especially for typical benthic feeders.

Key words: COMMON BREAM (*ABRAMIS BRAMA*), RUFFE (*GYMNOCEPHALUS CERNUUS*), ROACH (*RUTILUS RUTILUS*), PIKEPERCH (*SANDER LUCIOPERCA*), DIET, BENTHIC FAUNA, DAM RESERVOIR

INTRODUCTION

Small-sized fish, especially at 0-age, constitute an important link in the metabolic transformations of aquatic ecosystems. They occur in the environment in high concentrations and have fast metabolism and significant food needs; thus, they can impose strong pressure on populations of prey. The growth of 0-age fish is intense so an abundance of appropriate food is especially important. The significant role of zooplankton in the feeding of fry is described in the literature (Kurmayer and Wanzebock 1996, Flik et al. 1997, Machaček and Matěna 1997, Mehner et al. 1997, Post and Kitchell 1997, Ringelberg et al. 1997). There are fewer works on the significance of other organisms in the fry diet. Zooplankton is a basic source of food for 0-age fish, especially in spring and early summer, during and shortly after the larval period when, mainly due to the small size of the mouth opening, they are unable to catch larger prey

(Hartmann 1986, Garner 1996). In late summer and fall, older fry is able to consume larger prey and it may graze on benthic invertebrates. The proportions of zooplankton and zoobenthos in the food may vary at this time depending on the supply of invertebrates (prey) and the density and sizes of particular species of predatory fish in the environment (Terlecki 1993).

The Włocławek Reservoir in the lower Vistula River is a special basin in that it has significant water trophy and strong currents. The riverine character of the reservoir diminishes the adverse effects of eutrophication and prevents the creation of lasting oxygen deficits and Cyanophyceae blooms. The zooplankton in the reservoir, although quantitatively and qualitatively rich for its river-like environment, does not reach high densities (Napiórkowski 1997). The abundance of zoobenthos, however, is great. In the 1980s, a decade after the reservoir had been filled, the progressive sedimentation of it ultimately provided advantageous trophic and oxygen conditions which supported the profuse development of these zoobenthos (Giziński et al. 1989, Żytkowicz et al. 1990). Unusually high densities of benthic fauna were observed in the reservoir in the late 1990s, and the biomass of chironomid larvae alone periodically reached 0.5 kg m^{-2} (Żbikowski 2000, Żbikowski – unpublished data).

The aim of this work is to preliminarily evaluate the degree to which the very rich benthic fauna in the Włocławek Reservoir is preyed upon by juvenile stages of the most important fish species and to determine what impact this diet has on fish growth rate.

MATERIAL AND METHODS

STUDY AREA

The Włocławek Reservoir has the largest surface area (approximately 70 km^2) of all the Polish dam reservoirs. It was built in 1963 – 1970 at kilometer 675 of the Vistula River. It is a shallow, highly eutrophic basin but also highly rheolimnic. The highly dynamic water means that there is no thermal stratification or long-term oxygen deficiency (Giziński et al. 1989). The average depth of the reservoir is 5.5 m, and its maximum depth is 15 m near the dam. Its shape is typically riverine, and it is 57 km long with a width ranging from 500 to 2,500 m (average – 1,250 m). The retention time at an average flow of approximately 900 m s^{-1} is only 4 – 5 days. The average abundance (specimens dm^{-3}) and biomass (μg dry weight dm^{-3}) of the pelagic zooplankton in the reservoir in 1994 – 1995 were as follows: Rotatoria - 442, 32.6; Copepoda - 104.0, 70.6; Cladocera - 7.5, 10.3 (Napiórkowski 1997). In 1997-1998 the average abundance (specimen m^{-2}) and biomass (g wet weight m^{-2}) of the basic benthic fauna groups in the reservoir segment where the studied fish were caught (between kilometers 645 and 660 of the Vistula) were Chironomidae – 12 thous., 212, Oligochaeta – 59 thous., 188, Mollusca – 4 thous., 1,798, respectively (Żbikowski – unpublished data): The fish biomass in the Włocławek Reservoir is estimated at 200 kg ha^{-1} (Sych 1997). Common bream *Abramis brama* (L.) and roach *Rutilus rutilus* (L.) dominate in commercial catches, while pikeperch *Sander lucioperca* (L.) is the main predator.

SAMPLING AND ANALYTICAL TECHNIQUES

The fish used in the studies were caught in the upper part of the Włocławek Reservoir on a shallow bank about 0.5 – 2 m in depth which surrounds a sandy peninsula located near on the right bank of the reservoir at km 640-641 of the Vistula River. The bottom at this station is silt-sandy, there are rushes near the shore and it is a natural spawning ground and habitat for juvenile stages of many fish species. Catches were conducted on 21 July, 24 August and 5 October 1999 using a fry seine net (wing span - 15 m, wing - 8 mm mesh, bunt - 4 mm mesh). Each sample collection consisted of 2 or 3 hauls made in the late afternoon or early evening along a 40 – 50 meter transect of the shore zone. The specimens obtained were preserved in a 10% formaldehyde solution. In the laboratory they were measured (body length – *longitudo corporis*; Sl) to the nearest mm and weighed to the nearest 0.1 g. In order to determine the food composition, the digestive system contents of a total of 61 common bream and 53 roach and the stomach contents of 48 pikeperch and 44 ruffe *Gymnocephalus cernuus* (L.) were studied (Tables 1-3).

The fish food was studied under microscopes using a Sedgwick–Rafter chamber. The weight contribution and the frequency of occurrence of particular food components were determined (Hyslop 1980). The contribution of fish to the food was determined by direct weighing, while the contribution of crustaceans, larvae and insect pupae were estimated using weight standards (Szumiec – unpublished data). The weight of the molluscs from the family Sphaeriidae was reconstructed by completely drying the remains at a temperature of 60°C. After determining the dry weight, the approximate wet weight value was derived using Jasińska (1994) who reports that degree of Sphaeriidae hydration is 75%. The contribution of Oligochaeta, fragments of vascular plants, algae, Cyanophyceae, sand and detritus was evaluated using the point method. The food sample was studied in a Sedwick-Raftera chamber under a stereoscope microscope. The contribution of the components listed above was evaluated within the field of vision, expressed as the percentage of the sample volume and then recalculated as the contribution to the food mass.

RESULTS

Table 1 presents the food structure of studied common bream specimens with an average body length ranging from 5.1 ± 0.4 to 6.7 ± 0.5 cm.

TABLE 1

Weight (expressed in %) and frequency of occurrence of components in the common bream diet, Włocławek Reservoir, 1999

Food components	Catch dates		
	21 July	24 August	5 October
Chydoridae	60 (100)	53 (100)	27 (100)
Copepoda	1 (25)	-	+ (10)
Chironomidae (larvae)	23 (70)	39 (85)	65 (100)
Ostracoda	13 (90)	8 (80)	+ (15)
Amphipoda	3 (15)	-	+ (5)
Oligochaeta	+ (5)	-	+ (5)
Sphaeriidae	-	-	6 (50)
Algae	+ (80)	+ (75)	+ (65)
Sl ± SD	5.1 ± 0.4	5.3 ± 0.4	6.7 ± 0.5
W ± SD	2.6 ± 0.7	3.1 ± 0.7	5.9 ± 1.2
N	20	21	20

Numbers without parentheses denote the percentage of a given component in the food mass; numbers in parentheses denote the frequency of occurrence (in %); + denotes less than 1%; Sl – average body length (l.c.) in cm; W – average body weight in g; SD – standard deviation; n – number of fish studied

Between July and October, common bream mainly ate benthic cladocerans from the family Chydoridae and Chironomidae larvae. Of the other organisms consumed, only Ostracoda were eaten in large quantities. Of the Chydoridae found in the food, *Leydigia* sp. dominated, and *Alona* sp. and *Disparalona rostrata* Koch were also relatively numerous. On average, these taxa constituted 90. 4 and 4%, respectively, of the total mass of the Chydoridae consumed. Chironomidae larvae were mostly represented by the pelophilous form of the genus Chironomus (97% of the consumed mass chironomids). Only 3% of the larvae mass were forms from other Chironomidae genera (Cryptochironomus, Procladius and Glyptotendipes). A clear shift in common bream dietary preferences during the vegetation season from zooplankton to zoobenthos was observed. In comparison with July, there were far more chironomids and fewer cladocerans in the diet in October.

Between July and October, roach with an average body length ranging from 5.1 to 7.0 cm fed mainly on flora, Chironomidae larvae and small molluscs Sphaeriidae (Table 2). Amphipoda, Oligochaeta and zooplankton (single Cladocera and Copepoda) played a supporting role in the roach diet. Fragments of macrophytes mixed with detritus and algae (green algae and diatoms) dominated the flora segment of the diet. The amount of filamentous algae was considerably lower and the contribution of Cyanophyceae was even smaller. The Chironomidae in the food were represented by the larvae of *Chironomus* sp. It is also worth mentioning that small cycloid scales were found in the food.

TABLE 2

Weight (expressed in %) and frequency of occurrence of components in the roach diet, Włocławek Reservoir, 1999

Food components	Catch dates		
	21 July	24 August	5 October
Chironomidae (larvae)	23 (50)	9 (60)	52 (92)
Sphaeriidae	29 (75)	36 (60)	23 (46)
Amphipoda	-	+ (55)	+ (23)
Oligochaeta	-	+ (15)	+ (15)
Zooplankton	-	+ (30)	+ (15)
Flora:			
Macrophytes (+detritus)	20	15	7
Filamentous algae	4	5	2
Green algae	11	14	6
Diatoms	11	16	7
Cyanophyceae	2	4	1
Total (flora):	48 (100)	54 (100)	23 (100)
Others*	-	+ (?)	+ (?)
Sl	5.1	6.4	7.0
W	2.5	5.1	7.1
N	20	20	13

* *sand, fish scales; ? – no data, other notation as in Table 1.*

Fish and different developmental stages of Chironomidae constituted the main food of pikeperch (average body length from 7.0 ± 0.9 to 12.1 ± 1.6 cm Sl) during the study period (Table 3). Only in July were residual amounts of zooplankton and molluscs Sphaeriidae observed in their food.

TABLE 3

Weight (expressed in %) and frequency of occurrence of components in the pikeperch and ruffe diets, Włocławek Reservoir, 1999

Food components	Fish species and catch dates					
	Pikeperch			Ruffe		
	21 July	24 August	5 October	21 July	24 August	5 October
Fish	72 (60)	41 (30)	57 (36)	-	-	-
Chironomidae*	28 (50)	59 (77)	43 (55)	99 (72)	100 (100)	100 (80)
Amphipoda	+ (20)	-	-	+ (28)	+ (22)	+ (10)
Sphaeriidae	+ (20)	-	-	-	-	-
Zooplankton	+ (5)	-	-	+ (4)	-	-
Sl ± SD	7.0 ± 0.9	8.7 ± 1.0	12.1 ± 1.6	5.0 ± 0.2	7.0 ± 0.3	7.7 ± 0.7
W ± SD	4.9 ± 1.8	9.3 ± 3.0	24.9 ± 4.7	2.9 ± 0.3	7.1 ± 0.7	10.4 ± 3.1
N	20	17	11	25	9	10

* *total larvae and pupae; other notation as in tables 1 and 2*

Ruffe (average body length ranging from 5.0 ± 0.2 to 7.7 ± 0.7 cm) consumed Chironomidae larvae and pupae almost exclusively (Table 3). They also consumed very small amounts of Amphipoda and ate zooplankton sporadically.

DISCUSSION

The results of the study indicate that in 1999 after common bream, pikeperch, roach and ruffe had reached a body length of approximately 5 cm, they practically did not feed on the pelagic zooplankton crustaceans in the Włocławek Reservoir. However, benthic fauna constituted a very important dietary component of these fish. This is typical only of ruffe, which, after reaching a body length of 5 cm, is usually an obligatory benthivorous fish (Boroń and Kuklińska 1987, Wolnomiejski and Grygiel 1994, Kangur and Kangur 1996, Rēsch and Schmidt 1996, , Kangur et al. 2000a, 2000b). For the other fish species mentioned, juvenile stage grazing on such large quantities of zoobenthos and Chironomidae pupae is rather a rare phenomenon. Terlecki (1993), using multiple regression analysis in a lowland dam reservoir, demonstrated that 90 – 100% of the changes which occur in the structure of small-sized fish food are explained by three factors: (1) invertebrate prey stocks in the environment; (2) numbers of predatory fish (fry and small-sized fish species); (3) predator body sizes. In dam reservoirs these factors are largely dependent on the hydrological regime and the shape of the reservoir (the character of the shoreline). The water current slows zooplankton development, but it may stimulate the development of zoobenthos. The character of the shore area has a significant impact on the effectiveness of spawning and fry abundance.

Small common bream and roach specimens which are several centimeters long usually graze on larger amounts of benthic fauna in rivers and dam reservoirs with strong currents (Pliszka et al. 1951, Terlecki et al. 1990, Terlecki 1993). In lakes, ponds, lagoons and limnetic (stratified) dam reservoirs, where zooplankton crustacean development is abundant, its contribution to the fish diet is usually significant (Machaček and Matěna 1997, Matěna 1998, Angelibert et al. 1999, Horppila et al. 2000). In different types of water, pikeperch becomes typically piscivorous very early, i.e. in the first year of life. Frankiewicz (1998) reported that the pikeperch juvenile feeding pattern may switch to fish as soon as body length reaches 3 cm, and by the time it is 5–7 cm it must eat fish to continue growing normaly. Invertebrates also occur in the food of small pikeperch (from several to more than a dozen cm in length); however, these are mainly plankton forms, e.g. larvae or Chaoboridae pupae, large Copepoda *Leptodora kindti* or *Neomysis vulgaris*, which usually occur in lagoons near seas (Wiktor 1954, Filuk 1955, Nagięć 1966).

The lower Vistula River Włocławek Reservoir is an example of a typical riverine, oblong, strongly rheolimnetic dam reservoir. The abundance of the pelophilous zoobenthos in the reservoir is enormous, while zooplankton is far less abundant (see Study Area section). The oblong shape of the reservoir does not support effective spawning, thus the abundance of fry is probably not too high. These conditions mean that the early developmental stages of different fish species largely satisfy their energy needs with zoobenthos and planktonic chironomid pupae. This food is more attractive for small common bream and roach than pelagic planktonic crustaceans, and for pikeperch it is just as attractive as fish.

Due to the high contribution of benthic fauna in the food of juvenile specimens of many fish species in the Włocławek Reservoir, the following issue must be raised: Is this a good food base for them, i.e. does it ensure high weight and length growth? In the case of common bream the answer is yes. In this environment, the abundant occurrence of benthic macrofuna, a food component of equal value to Chydoridae, has a positive impact on the growth of these fish. Back calculations were performed on the scales of 150 common bream of different sizes, and it was revealed that after the completion of the first year of life in the reservoir they reach an average body length of

8.5 cm (Kakareko 2001). This value is high for common bream and is a figure rarely observed in Poland (Marciak 1974). The growth rate of the other fish species has not been determined yet; however, if the studied fish are 0-age, which is likely, then the reported body sizes in October would indicate very good growth increments for both roach and ruffe. In the majority of Polish lakes 0-age roach attain a body length of slightly more than 4 cm (Brylińska 2000), while in the Włocławek Reservoir the average body length of roach was recorded in direct measurements at 7.0 cm. Depending on the environmental conditions, 0+ ruffe grow differently. In Lake Tajty it reached 3.5 cm Sl (Zawisza 1953), in the Szczecin Lagoon, Lake Dąbie and Roztoka Odrzańska it ranged from 5.8 to 6.0 cm (Neja 1989), in Lake Constance it was 7.6 cm (Rēsch and Schmidt 1996) and in the Vistula Lagoon it measured 8.0 cm (Rychter 1997). In October the average body length of the ruffe caught in the Włocławek Reservoir was 7.7 cm. Based on the Brylińska (2000) data, it can be preliminarily stated that 0-age pikeperch growth in the reservoir is average. A more comprehensive answer regarding the impact of abundant benthic fauna on the growth of small roach, ruffe and pikeperch in the reservoir will be obtained when growth rate studies have been completed on a representative number of specimens from these species.

This paper presents the preliminary stage of studies on the feeding patterns of small fish in the Włocławek Reservoir. There are plans to continue this work by expanding the study to include determining the concentration and age of juvenile fish as well as to describe the dynamics of the invertebrate prey population which occurs in the environment at the catch sites.

ACKNOWLEDGEMENTS

The author would like to thank Jarosław Tomkiel, Marek Frankowski and Arkadiusz Antochów for their assistance during field studies and in the laboratory and Professor Andrzej Giziński for his valuable comments.

REFERENCES

Angelibert S., Brosse S., Dauba F., Lek S. 1999 - Changes in roach (*Rutilus rutilus* L.) population structure induced on draining a large reservoir - Comptes Rendus de l'Academie des Sciences Serie III Sciences de la Vie 322 (4): 331-338.

Boroń S., Juklińska B. 1987 - Food of ruffe (*Gymnocephalus cernuus* L.) and gudgeon (*Gobio gobio* L.) in Włocławek Dam Reservoir - Acta Ichthol. Piscat. XVII, 1: 59-76.

Brylińska M. 2000 - Polish freshwater fish - PWN, Warszawa, 521 pp. (in Polish).

Filuk J. 1955 - The results of the studies on the pikeperch stock in the Vistula Lagoon in 1951-1952 - Prace MIR 8: 69-94 (in Polish).

Flik B. J. G., Aanen D. K., Ringelberg J. 1997 - The extent of predation by juvenile perch during diel vertical migration of *Daphnia* - Arch. Hydrobiol. Spec. Issues Advanc. Limnol. 49: 51-58.

Frankiewicz P. 1998 - Regulation mechanisms within a fish assemblage and their impact, through the cascade effect, on the quality of water in a lowland dam reservoir - Wyd. UŁ, Łodź, 127 pp. (in Polish).

Garner P. 1996 - Microhabitat use and diet of 0+ cyprinid fishes in lentic, regulated reach of the River Great Ouse, England – J. Fish Biol. 48: 367-382.

Giziński A., Błędzki L., Kentzer A., Wiśniewski R., Żytkowicz R. 1989 - Hydrobiological characteristic of the lowland, rheolimnic Włocławek Reservoir on the Vistula River - Ekol. pol. 37: 359-404.

Hartmann J. 1986 – Interspecific predictors of selected prey of young fishes - Arch. Hydrobiol. Beih. Ergebn. Limnol. 22: 373-386.

Horppila J., Ruuhijarvi J., Rask M., Karppinen C., Nyberg K., Olin M. 2000 - Seasonal changes in the diets and relative abundances of perch and roach in the littoral and pelagic zones of a large lake - J. Fish Biol. 56 (1): 51-72.

Hyslop E. J. 1980 - Stomach content analysis-a review of methods and their application - J. Fish Biol. 17: 411-429.

Jasińska I. 1994 – The biometry of molluscs Sphaeriidae in the Włocławek Reservoir - MS thesis. UMK, Toruń (in Polish).

Kakareko T. 2001 - The diet, growth and condition of common bream, *Abramis brama* (L.) in Włocławek Reservoir - Acta Ichthyol. Piscat. 31 (2): 37-53.

Kangur K., Kangur A. 1996 - Feeding of ruffe (*Gymnocephalus cernuus*) in relation to the abundance of benthic organisms in Lake Vortsjarv (Estonia) - Ann. Zool. Fennici 33: 473-480.

Kangur K., Kangur A., Kangur P. 2000a - Diet composition and food consumption level of ruffe, *Gymnocephalus cernuus* (L.), in Lake Peipsi - Proceedings of the Estonian Academy of Sciences Biology 49 (1): 121-135.

Kangur K., Kangur A., Kangur P. 2000b - A comparative study on the feeding of eel, *Anguilla anguilla* (L.), bream, *Abramis brama* (L.) and ruffe, *Gymnocephalus cernuus* (L.) in Lake Vortsjarv, Estonia - Hydrobiologia 408-409: 65-72.

Kurmayer R., Wanzebock J.1996 - Top-down effects underyearling fish on a phytoplankton community – Freshwat. Biol. 36: 599-609.

Machaček J., Matěna J. 1997 - Diurnal feeding patterns of age-0 perch (*Perca fluviatilis*) and roach (*Rutilus rutilus*) in a steep-sided reservoir - Arch. Hydrobiol. Spec. Issues Advanc. Limnol. 49: 59-70.

Marciak Z. 1974 – A description of common bream – *Abramis brama* (Linnaeus, 1758) in Polish lakes - Rocz. Nauk Rol. 96-H-3: 75-95 (in Polish).

Matěna J. 1998 - Diet spectra and competition between juvenile fish in the pelagic zone of a deep stratified reservoir during the first year of life - Internat. Rev. Hydrobiol. 83, Special Issue: 577-584.

Mehner T., Plewa M., Hulsmann S., Voight H., Benndorf J. 1997 - Age-0 fish predation on daphnids - spatial and temporal variability in the top-down manipulated Bautzen Reservoir, Germany - Arch. Hydrobiol. Spec. Issues Advanc. Limnol. 49: 13-25.

Nagięć M. 1966 - Feeding patterns of pikeperch – *Abramis brama* (L.) fry in the lakes from the Mazurian Lake District - Zesz. Nauk. WSR Olsztyn 21: 583-600 (in Polish).

Napiórkowski P. 1997 - The influence o Włocławek Dam Reservoir on the composition, abundance and biomass of zooplankton in low Vistula River - 3rd International Conference on Reservoir Limnology and Water Quality, Česke Budejovice, Czech Republic, 11-15.09.1997, Book of abstracts: p. 124.

Neja Z. 1989 - The growth rate of ruffe, *Gymnocephalus sernuus* (L. 1758) in the Szczecin Lagoon, the Odra Mouth and Lake Dąbie - Acta Ichthyol. Piscat. XIX, 1: 3-19.

Pliszka F., Backiel T., Dziekońska J., Kossakowski J., Włodek S. 1951 - Studies of fish feeding patterns in the Vistula River - Rocz. Nauk Rol. 57: 205-236 (in Polish).

Post D. M., Kitchell J. F. 1997 - Trophic ontogeny and life history effects on interactions between age-0 fishes and zooplankton - Arch. Hydrobiol. Spec. Issues Advanc. Limnol. 49: 1-12.

Ringelberg J., Flik B. J. G., Aanen D. & van Gool E. 1997 - Amplitude of diel vertical migration (DVM) is a function of fish biomass, a hypothesis - Arch. Hydrobiol. Spec. Issues Advanc. Limnol. 49: 71-78.

Rēsch R., Schmidt W. 1996 - Ruffe (*Gymnocephalus cernuus* L.), newly introduced into Lake Constance: preliminary data on population biology and possible effects on whitefish (*Coregonus lavaretus* L.) - Ann. Zool. Fennici 33: 467-471.

Rychter A. 1997 - Selected elements of the biology of ruffe (*Gymnocephalus cernuus* L.) of the Vistula Lagoon - Bulletin of the Sea Fisheries Institute 2(141): 55-65.

Sych R. 1997 - Some ideas regarding fish concentrations, examples from dam reservoirs – Conference Proceedings. The role of angling in the protection of waters and fish stocks, Łódź 26-27.05.1997. Wydawnictwo PZW, Warszawa, (in Polish).

Terlecki J. 1993 – Feeding relations among small fish based on the example of the shoreline of a lowland dam reservoir - Acta Acad. Agricult. Tech. Olst., Protectio Aquarum et Piscatoria 19, Supp. C: 58 pp. (in Polish).

Terlecki J., Tadajewska M., Szczyglińska A. 1990 - Feeding patterns of commercially valuable fish species in the Zegrzyński Reservoir and their intraspecific and interspecific relationships – In: The functioning of aquatic ecosystems, their protection and recultivation. Part I. Ecology of dam reservoirs and rivers 50 (Ed.) Kajak Z., SGGW-AR, Warszawa, 201-225 (in Polish).

Wiktor J. 1954 - An analysis of the pikeperch stock in the Szczecin Lagoon - Prace MIR 7: 49-61 (in Polish).

Wolnomiejski N., Grygiel I. 1994 - Studies on benthos and fish food in the Szczecin Lagoon - MIR, Studia i Materiały, Seria B, Nr 64, (in Polish).

Zawisza J. 1953 - Fish growth in Lake Tajty - Rocz. Nauk Rol. H-63: 221-257 (in Polish).

Żbikowski J. 2000 - Macrozoobenthos of the Vistula in the section from Wyszogród to Toruń - AUNC, Limnol. Papers 21: 75-84.

Żytkowicz R., Błędzki L. A., Giziński A., Kentzer A., Wiśniewski R., Żbikowski J. 1990 - The Włocławek Reservoir. An ecological description of the first dam reservoir in the cascade planned for the lower Vistula River – In: Functioning of aquatic ecosystems, their protection and recultivation. Part I. Ecology of dam reservoirs and rivers 50 (Ed.) Kajak Z., SGGW-AR, Warszawa, 201-225, (in Polish).

STRESZCZENIE

ZNACZENIE FAUNY DENNEJ W ODŻYWIANIU SIĘ MAŁYCH LESZCZY *ABRAMIS BRAMA* (L.), PŁOCI *RUTILUS RUTILUS* (L.), SANDACZY *SANDER LUCIOPERCA* (L.) I JAZGARZY *GYMNOCEPHALUS CERNUUS* (L.) W ZBIORNIKU WŁOCŁAWSKIM

Zbadano skład pokarmu 61 małych leszczy i 53 płoci oraz 48 małych sandaczy i 44 jazgarzy pozyskanych ze Zbiornika Włocławskiego 21 lipca, 24 sierpnia i 3 października 1999 roku. Ryby odławiano późnym popołudniem lub wieczorem, w płytkim (0,5-2 m głębokości) pasie przybrzeżnym (40-50 m szerokości) w rozlewiskowej części zbiornika, przy prawym brzegu na wysokości około 640-641 km biegu Wisły.

W pokarmie badanych ryb dominował zoobentos i pelagiczne poczwarki Chironomidae. Wrotkowo-widłonogowo-wioślarkowy zooplankton pelagiczny nie był prawie wcale zjadany. Leszcz spożywał głównie naddenne wioślarki Chydoridae oraz larwy Chironomidae (łącznie w poszczególnych miesiącach stanowiły one od 83 do 92% udziału wagowego – tab. 1), płoć – pokarm roślinny, larwy Chironomidae oraz drobne małże Sphaeriidae (od 98 do 100% – tab. 2), jazgarz – larwy Chironomidae (od 99 do 100% – tab. 3), a sandacz – ryby i różne stadia rozwojowe Chironomidae (od 99 do 100% – tab. 3). Wśród zjadanych larw ochotkowatych dominowały pelofilne formy z rodzaju Chironomus.

Zbiornik Włocławski jest typowo rzecznym, silnie przepływowym (czas retencji wynosi 4-5 dni), płytkim i wysoce eutroficznym zbiornikiem zaporowym. Obfitość fauny dennej jest w nim wyjątkowo

duża, a zooplanktonu pelagicznego jest znacznie mniej. W takich warunkach zoobentos jest atrakcyjnym źródłem pokarmu dla różnych gatunków ryb (zróżnicowanych pod względem możliwości pobierania pokarmu dennego) i już od wczesnych etapów ich życia odgrywa ważną rolę w odżywianiu się. Stwarza to dogodne warunki do rozwoju zwłaszcza dla typowych bentosożerców.

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