

Arch. Pol. Fish.	Archives of Polish Fisheries	Vol. 16	Fasc. 1	75-86	2008
---------------------	---------------------------------	---------	---------	-------	------

## METAZOAN PARASITE FAUNA OF FISH SPECIES FROM LAKE KORTOWSKIE

*Ewa Dzika\**, *Marzena Kuształa\**, *Jacek Kozłowski\*\**

\*Department of Zoology, University of Warmia and Mazury in Olsztyn, Poland

\*\*Department of Fish Biology and Pisciculture, University of Warmia and Mazury in Olsztyn, Poland

ABSTRACT. Parasitological studies of fish from Lake Kortowskie were carried out from 2001 to 2004. In the current study, 381 fish representing ten species: perch, *Perca fluviatilis* L., bleak, *Alburnus alburnus* (L.), ruffe, *Gymnocephalus cernuus* (L.), silver bream, *Abramis bjoerchna* (L.), pike, *Esox lucius* L., common gudgeon, *Gobio gobio* (L.), tench, *Tinca tinca* (L.), rudd, *Scardinius erythrophthalmus* (L.), bream, *Abramis brama* (L.) and roach, *Rutilus rutilus* (L.) were examined. The aim of the study was to review the parasites of selected fish species and to compare the infestation of bream, perch, and rudd in 1984-88, 1994 and 2001-2003. A total of 51 species of parasites belonging to Monogenea (27), Digenea (6), Cestoda (7), Nematoda (4), Acanthocephala (3), Crustacea (3), and Mollusca (1) were recorded. The largest numbers of parasite species were found in roach (18), followed by bleak (14), perch and silver bream (13), bream (11), ruffe and pike (10), and the fewest in common gudgeon (4) and tench and rudd (2). *Tetraonchus monenteron*, *Triaenophorus nodulosus*, *Ergasilus sieboldi*, and molluscs glochidia occurred in 83.3% of the pike. Comparing the bream, perch, and rudd infestation parameters of over twenty years with the current results, it can be concluded that the changes are linked to environmental changes that have occurred as a consequence of the Lake Kortowskie experiment.

Key words: METAZOAN PARASITE, FISH, LAKE KORTOWSKIE

## INTRODUCTION

Metazoan parasites have a harmful effect on both fish health and fisheries. Fish production is affected and fish diseases become serious problem. However, specific species of parasitofauna in fishes from Lake Kortowskie can be used as bioindicators that provide information about the condition of the environment.

Lake Kortowskie is located within the city limits of Olsztyn, and is a bream lake (Waluga and Chmielewski 1996). Its surface area is 90.4 ha, the maximum depth is 17.2 m, and the average depth is 6.4 m (Jańczak et al. 1999). This is a eutrophic lake, and, since 1959, it has been purified; waters from the hypolimnion have been removed by a special pipeline to the Kortówka River. This experiment has been continued up to the present. In

---

CORRESPONDING AUTHOR: Ewa Dzika, Uniwersytet Warmińsko-Mazurski, Katedra Zoologii, ul. Oczapowskiego 5, 10-957 Olsztyn; Tel. +48 89 5234393, e-mail: e.dzika@uwm.edu.pl

Lake Kortowskie, 86.6% of the fish population are bream, *Abramis brama* (L.) (23.6%), roach, *Rutilus rutilus* (L.) (22.6%), perch, *Perca fluviatilis* L. (20.3%), and pike, *Esox lucius* L. (20.2%). The share of the remaining 22 species is about 13.4% (Kozłowski pers. inf). This lake is not subject to fisheries exploitation. Only a few parasitological studies have been conducted in this lake: on bream in 1984 (Kukliński 1984, 1994, Dzika 2002), on perch in 1988 (Król and Ochendowski 1988), and on rudd, *Scardinius erythrophthalmus* (L.) in 1984 (Własow et al. 1991). The current study had two objectives: first, to determine the prevalence and intensity of Metazoan parasites in bream, perch, and rudd from Lake Kortowskie; second, to compare current data with relevant data reported in earlier papers.

## MATERIAL AND METHODS

Fish were examined in 2001-2004 in April, May, and June. The study examined a total of 381 fishes, representing ten species (Table 1). Parasitological research included skin, heart, fins, gills, eyes, alimentary tract, liver, spleen, kidney, gall bladder, swim bladder, and brain. Preparations of parasites were made by general methods used in parasitology (Lonc and Złotorzycka 1995). The parasites were identified according to keys by Gusev (1985), Bauer (1987), Pojmańska (1991), and Niewiadomska (2003). Dominant, common, rare, and sporadic species were calculated according to Pojmańska et al. (1980).

TABLE 1

Characteristic of the studied fish				
Species	N	Infested fishes (%)	Length range (cm)	Weight range (g)
<i>Abramis bjoerana</i> (L.)	76	72.4	10 - 21	8.4 - 122.1
<i>Rutilus rutilus</i> (L.)	66	89.4	11 - 21	12.0 - 98.6
<i>Perca fluviatilis</i> L.	56	85.7	7 - 31	3.7 - 554.8
<i>Gymnocephalus cernuus</i> (L.)	55	100.0	9 - 14	6.7 - 25.9
<i>Abramis brama</i> (L.)	48	25.0	11 - 33	10.3 - 399.6
<i>Alburnus alburnus</i> (L.)	46	87.0	11 - 15	7.6 - 21.3
<i>Gobio gobio</i> (L.)	13	76.9	5 - 13	7.5 - 21.6
<i>Scardinius erythrophthalmus</i> (L.)	10	60.0	11 - 13	15.3 - 31.4
<i>Esox lucius</i> L.	6	100.0	40 - 50	462.2 - 933.7
<i>Tinca tinca</i> (L.)	5	100.0	9 - 12	9.6 - 27.4

## RESULTS

A total of 51 parasite species were recorded from the fish necropsies. The parasites represented seven higher taxa: Monogenea (27 species), Digenea (6), Cestoda (7), Nematoda (4), Acanthocephala (3), Crustacea (3), and Mollusca (1). The lowest numbers of parasite species were recorded in gudgeon, *Gobio gobio* (L.), tench, *Tinca tinca* (L.) and rudd (Table 2). The parasite fauna of roach from this lake was definitely the most abundant (18 species). Of the 11 Monogenea species found on gills, *Dactylogyrus caballeroi*, *D. crucifer* (18.5%), *Paradiplozoon Megan* (23.1%), and *P.h. homoion* (20.5%) were the most abundant. The remaining species were found sporadically. Metacercariae of *Diplostomum* sp., (28.2%), *Tylodelphys clavata* (43.6%), tapeworm *Paradilepis scolecina* (25.6%), and copepods *Caligus lacustris* (10.2%) occurred commonly. Gills hosted *Ergasilus sieboldi*, *Postodiplostomum cuticula* (mc.), and molluscs glochidia were found on the fins.

The parasite fauna of bleak, *Alburnus alburnus* (L.) from Lake Kortowskie was represented by 14 species. Monogenea were represented by 7 species. The specialist species *D. parvus* (11.9%) occurred commonly on gills, but the remaining species occurred rarely and sporadically. Metacercariae of *Diplostomum* sp. (9.5%) were found in eye lenses. Tapeworms *P. scolecina* (45.2%) were the most numerous in the examined material (713 specimens were found in bleak livers). One specimen of *Proteocephalus* sp. was found in the intestine of one fish. *Caligus lacustris*, *Argulus foliaceus*, and *Glochidium* occurred on fins, and *E. sieboldi* was noted on gills.

In the case of perch, 13 parasite species were recorded. Metacercariae of *Diplostomum* sp. were found in the eye lens of one fish only, while *T. clavata* (33.9%) occurred most abundantly (518 specimens were found). Tapeworms *Proteocephalus percae* (248 specimens) and plerocercoids of *Triaenophorus nodulosus* (12 specimens) were found in the intestine and liver. *Camallanus lacustris* occurred rarely in the intestine, and one *Desmidocercella numidica* larvae was found in the vitreous humour of the eye of one fish. *A. anguillae* was numerous and 159 specimens were found in intestines. Copepods *E. sieboldi*, *Caligus lacustris*, and *Argulus foliaceus* were found on gills and fins, while molluscs glochidia (63 specimens) were found on fins.

In silver bream, *Abramis bjoerchna* (L.) 13 species of parasites were found. Monogenea were represented by 6 species. Monogenean worms occurred rarely and sporadically on the gills of fish. The metacercariae of *Diplostomum* sp. were the most

prevalent (52.6%) and abundant (mean intensity 19.92) In eye lenses, 797 specimens were found. The remaining parasites, metacercariae digenean flukes, tapeworms, and copepods, settled in different organs of the fish and occurred rarely and sporadically.

All of the ruffe, *Gymnocephalus cernuus* (L.) (55 specimens) examined were infected with parasites. A total of ten species of parasite were noted. *Dactylogyrus amphibotrium* occurred commonly on gills (34.5%). The most prevalent were metacercariae of *Diplostomum* sp. (76.5%) and *Tylodelphys clavata* (70.9%). Metacercariae of *Ichthyocotylurus platycephalus* (12.7%) were found in the heart, while *Proteocephalus percae* (69.1%), one specimen of nematode (1.8%), *Acanthocephalus anguillae* (43.6%), and *A. lucii* (5.5%) were noted in the alimentary tract. The copepod *Ergasilus sieboldi* (45.4%) occurred commonly and molluscs glochidia (1.8%) sporadically. In total, this fish hosted 1205 specimens of countable parasites, of which 515 were *Tylodelphys clavata*.

All of the pike, *Esox lucius* L. (6) examined were infected with parasites. The gills were infected by *Tetraonchus monenteron* and *Ergasilus sieboldi*. The intestine hosted *Triaenophorus nodulosus* and *Raphidascaris acus*, and the fins hosted molluscs glochidia. These were the most prevalent parasite in the present study. The prevalence of infection was 83.3% for *Tetraonchus monenteron*, *Ergasilus sieboldi*, glochidia larvae and 50% for *Raphidascaris acus*. The remaining parasites, *Diplostomum* sp., *Tylodelphys clavata*, *Argulus foliaceus*, and *Caligus lacustris*, occurred less than abundantly. Adult 2 specimens of *Azygia lucii* were found in branchial chamber. In total, the fish hosted 691 specimens of parasites, of which there were 124 specimens of *Tetraonchus monenteron*, 219 specimens of *Ergasilus sieboldi*, and 138 specimens of *Triaenophorus nodulosus*.

Twelve specimens of bream were infected with eleven species of parasites. Five monogenetic worms occurred rarely and sporadically on bream gills. Digenetic flukes were represented by the metacercariae of *Diplostomum* sp., *Tylodelphys clavata*, and *Posthodiplostomum cuticola*. *Caryophyllaeus laticeps* was prevalent in the intestine (58.3%), and *Paradilepis scolecina* occurred rarely in the liver. In total, 333 parasites were collected (Table 2).



Cont. TABLE 2

## Parasites of fish in Lake Kortowskie and basic infection parameters (2001-2004)

Parasite species	Perch n=56		Bleak n=46		Ruffe n=55		Silver bream n=76		Pike n=6		Gudgeon n=13		Tench n=5		Rudd n=10		Bream n=12		Roach n=66		No of para- sites
	Int.		Int.		Int.		Int.		Int.		Int.		Int.		Int.		Int.		Int.		
	P(%)	mean	P(%)	mean	P(%)	mean	P(%)	mean	P(%)	mean	P(%)	mean	P(%)	mean	P(%)	mean	P(%)	mean	P(%)	mean	
<i>Diplostomum</i> sp. (mc.)	1.78	13	9.52	1	76.54	8.68	52.63	19.92	33.33	2					60	2.66	41.66	34	28.20	11.54	1489
<i>Tylodelphys clavata</i> (mc.)	33.92	26			70.90	13.35	18.42	4.85	50	15.33							33.33	5.25	43.58	18.11	1482
<i>Ichthyocotylurus platycephalus</i> met.					12.72	8.14															57
<i>Posthodiplostomum cuticula</i> (mc.)																	8.33	1	2.56	1	2
<i>Rhipidocotyle campanula</i> (mc.)							9.21	1.86													13
<i>Azygia lucii</i>									16.66	1											2
<i>Paradilepis scolicina</i> (pler.)			45.23	37.52			6.57	10			15.38	5.5					8.33	10	25.64	16.8	1042
<i>Triacnophorus nodulosus</i> (pler.)	5.36	4																			12
<i>Triacnophorus nodulosus</i>									83.33	27.6											138
<i>Caryophyllioides fennica</i>							1.32	2													2
<i>Caryophyllaeus laticeps</i>																	58.33	12			84
<i>Proteocephalus percae</i>	44.64	9.92			69.09	3.97															399
<i>Proteocephalus</i> sp.			2.4	1																	1
<i>Desmidocercella numidica</i> (lar.)	1.78	1																			1
<i>Camallanus lacustris</i>	7.32	3.25																			13
<i>Rhapidascaris acus</i>									50	1.33											4
Nematoda sp.					1.81	1															1
<i>Acanthocephalus anguillae</i>	23.21	12.23			43.63	1.45							20	1							196
<i>A. lucii</i>	3.57	2			5.45	1.33															6
<i>Acanthocephalus</i> sp.	3.57	2																			2
<i>Argulus foliaceus</i>	3.57	1	2.38	1					16.66	8											11
<i>Caligus lacustris</i>	7.14	1	28.3	1.4			7.86	1.16	16.66	1				10	2				10.25	3.75	43
<i>Ergasilus sieboldi</i>	17.86	4.4	4.76	1	45.45	2.32	6.57	1	83.33	43.8	7.69	1	80	8.5			16.66	2	5.12	1	367
<i>Glochidium</i>	25	4.5	7.14	1	1.81	3.0			83.33	14.2									5.12	1	142

*n*- no of fish examined

*P*- prevalence (%)

*Int. mean* – mean intensity

## DISCUSSION

Of the 51 parasite species found in Lake Kortowskie, the Monogenea, which are highly specific for particular host species, occurred on the gills and fins of the examined

fish and formed a very large group (27 species). Among the factors impacting the presence of these parasites, water temperature is of major importance. According to Dzika and Dubas (1988), species of *Dactylogyrus* react to changes in temperature; rapid increases of water temperature increases their reproductive activity and their expansion on the host, while a sudden drop in temperature inhibits reproduction. This corresponds with the results of the present study as samples were collected only during the spring months (April, May, June). On the other hand, increasing water temperature increases the resistance of fish to these parasites, which could be a mechanism reducing the numbers of parasites on individual host specimens during the summer and fall (Dzika 1987).

Of the ten fish species from Lake Kortowskie examined in the present study, previous studies focused on bream, perch, and rudd. During 1984 and 1994, the parasites of bream were studied by Kukliński (1984) and Dzika (2002) (Table 3). In 1984 and 1994, 14 species of parasites (excluding Protozoa) were recorded. From among five species of Monogenea found in the present study, in 1994 three (*Dactylogyrus auriculatus*, *D. wunderi*, *D. zandti*) and additionally *Gyrodactylus* sp. were found. In 1984, however, only *Gyrodactylus* sp. was noted. During all three periods of study, the eye digenean flukes *Tylodelphys clavata* and *Diplostomum* sp. were found. The extensity of infection with *Diplostomum* sp. in 1984 and 1994 was similar at 88% and 90.9%, respectively, while in the current study it decreased by half to 41.7%. The prevalence of occurrence of *Tylodelphys clavata* changed from 15.0% in 1984 to 67.2% in 1994 and then 33.3% during the 2001–2003 period. While *Paracenogoninus ovatus* (mc.), *Posthodiplostomum cuticola* (mc.), *Sanguinicola* sp. (ova), and *Sphaerostomum maius* were noted in 1984, they were not present in 1994. During the current study, only metacercariae of *Posthodiplostomum cuticola* were present and its prevalence increased eightfold. In 1994, *Ichthyocotylurus platycephalus* (mc.) and *Phyllodistomum elongatum* were noted, but they were not found during the current study. In all three study periods *Caryophyllaeus laticeps* was present and its extensity was similar in 1984 and 1994 at 26.6% and 21.8%, respectively. In the current study its prevalence doubled to 58.3%. In 1984, plerocercoids of *Ligula intestinalis* were found, which were not found in the later studies, while in 1994 and in the present study plerocercus forms of *Paradilepis scolecina* appeared. The extensity of infestation of fish with that tapeworm decreased threefold as compared to 1994. In 1994 only one species

of Acanthocephala, *Acanthocephalus lucii*, was recorded; however, it was not recorded in the present study. *Philometra* sp. was present in 1984 at an extensity of 13.3%, later, in 1994 its extensity decreased threefold to 5.4%, and then this species was absent from the 2001-2003 study. Among the three species of Crustacea found in 1984, in 1994 and in the present study, only one, *Ergasilus sieboldi*, was found. The extensity of infestation with this parasite decreased gradually from 43.3% in 1984 to 21.8% in 1994 and 16.6% at present. Larvae of molluscs glochidia were present with similar extensity (1.7% and 1.8%) in 1984 and 1994, while in the present study they were not found on the fish. For bream, a total of 23 parasite species were noted with 14 species in 1984 and 1994 and only 11 currently. During the years of study, the number of internal parasite species decreased from 9 to 5.

The second species of fish from Lake Kortowskie that was studied earlier was perch (Król and Ochendowski 1988; Table 3). During the current study, no Monogenea were found in perch, although in 1988 *Gyrodactylus* sp. was present. Eye digenea flukes were present in both 1988 and during the present study, but the extensity of infestation changed drastically with an eightyfold decrease in the presence of *Diplostomum* sp. and a threefold decrease in the prevalence of *Tylodelphys clavata*. During the current study, no *Bunodera luciopercae* were found. Among tapeworms, the plerocercoid of *Triaenophorus nodulosus* was present with similar extensity in both 1988 and during the current study, while *Proteocephalus percae* appeared during the present study only (44.6%). In both years, *Desmidocercella numidica* was present with similar prevalence while that of *Camallanus lacustris* decreased fourfold. In 1988, one species of Acanthocephala, *Acanthocephalus lucii* (16.3%), was present. In the current study *Acanthocephalus lucii* was also present but its prevalence decreased fivefold. On the other hand, *Acanthocephalus anguille* and *Acanthocephalus* sp. appeared. Of the three species of Crustacea, the prevalence of *Argulus foliaceus* decreased fourfold, while *Caligus lacustris* and *Ergasilus sieboldi* appeared. A tenfold increase in the infestation of perch with *Glochidium* larvae was observed. During the present study no leeches was observed, while in 1988 *Piscicola geometra* was present.



TABLE 3

Changes of parasite occurrence in bream, perch, and rudd in Lake Kortowskie during 1984-2003

Parasite species	Bream						Perch				Rudd			
	1984 n=60		1994 n=55		2001-2003 n=48		1988 n=92		2001-2003 n=56		1983-1984 n=40		2002-2003 n=10	
	P%	Inten- sity (range)	P%	Inten- sity (range)	P%	Inten- sity (range)/ mean intensity	P%	Inten- sity (range)	P%	Inten- sity (range)	P%	Inten- sity (range)	P%	Inten- sity (range)
<i>Dactylogyrus auriculatus</i>	-	-	5.4	1	2.77	4								
<i>D. falcatus</i>	-	-	-	-	5.55	1								
<i>D. wunderi</i>	-	-	9.1	1-4	5.55	4.5								
<i>D. zandti</i>	-	-	12.7	1-6	11.11	4								
<i>Dactylogyrus</i> sp.											sporadi- cally	-	-	-
<i>Gyrodactylus elegans</i>	-	-	-	-	8.36	7.66								
<i>Gyrodactylus</i> sp.	1.7	single	1.8	1	-	-	2.2	1	-	-				
<i>Diplostomum</i> sp. (mc.)	88	1-80	90.9	1-157	41.66	6-75	85.5	1-68	1.78	0-1	35	-	60	1-6
<i>Tylodelphys clavata</i> (mc.)	15	1-8	67.2	1-97	33.33	1-11	98.9	1-66	33.92	1-152	8	-	-	-
<i>Ichthyocotylurus platycephalus</i> (mc.)	-	-	1.8	1	-	-								
<i>Paracoegonius ovatus</i> (mc.)	35	1-28	-	-	-	-								
<i>Posthodiplostomum cuticola</i> (mc.)	1.7	0-3	-	-	8.33	0-1					15	-	-	-
<i>Sanguinicola</i> sp.	1.7	-	-	-	-	-								
<i>Sphaerosomum maius</i>	5	1-93	-	-	-	-								
<i>Bunodera luciopercae</i>							19.6	1-6	-	-				
<i>Phyllodistomum elongatum</i>	-	-	7.2	1-7	-	-								
<i>Caryophyllaeus laticeps</i>	26.6	1-73	21.8	1-50	58.33	1-18					28	-	-	-
<i>Proteocephalus percae</i>							-	-	44.64	1-65				
<i>Paradilepis scolecina</i> (pler.)	-	-	27.8	1-12	8.33	0-10								
<i>Ligula intestinalis</i> (pler.)	8.3	-	-	-	-	-								
<i>Triaenophorus nodulosus</i> (pler.)							6.5	1-5	5.36	1-6				
<i>Acanthocephalus lucii</i>	-	-	5.5	1-6	-	-	16.3	1-23	3.57	0-2				
<i>Acanthocephalus anguillae</i>							-	-	23.21	1-72				
<i>Acanthocephalus</i> sp.							-	-	3.57	0-2				
<i>Philometra</i> sp.	13.3	1-4	5.4	0-3	-	-								
<i>Camallanus lacustris</i>							30.4	1-16	7.14	1-8				
<i>Desmidocerella numidica</i>							sporadi- cally		1.78	0-1				
<i>Ergasilus sieboldi</i>	43.3	1-25	21.8	1-3	16.64	1-3	-	-	17.86	1-20	37	-	-	-
<i>Tracheliastes maculatus</i>	8.3	1-8	-	-	-	-								
<i>Argulus foliaceus</i>	5	1-2	-	-	-	-	14.1	-	3.57	0-1				
<i>Caligus lacustris</i>							-	-	7.14	0-1	-	-	10	0-2
<i>Glochidium</i> lar.	1.7	single	1.8	1	-	-	2.2	1-67	26	1-24				
<i>Piscicola geometra</i>							8.7	1-3	-	-				

Explanation see in table 2

The last species from Lake Kortowskie studied earlier was rudd (Własow et al., 1991; Table 3). Comparing the fauna of parasites from 1983-1984 with those from 2002-2003, it can be seen clearly that the number of parasite species decreased. Accord-

ing to Własow et al. (1991), six species of parasites were found on rudd (excluding Protozoa): *Dactylogyrus* sp.; *Diplostomum* sp.; *Tylodelphys clavata*; *Posthodiplostomum cuticola*; *Caryophyllaeus laticeps*; *Ergasilus sieboldi*. During the present study, only two species were found: *Diplostomum* sp. and *Caligus lacustris*, a new species. The prevalence of rudd infestation with *Diplostomum* sp. increased twofold.

The comparison of present infestation of bream and perch with that of 1984 and 1994, clearly shows that there has been a decrease in the number of species, decreases in prevalence or increases (sometimes dramatic), and the disappearance of some species and the appearance of new ones. In the case of perch parasites, during the current study no *Bunodera lucioperca* were recorded, the prevalence of *Camallanus lacustris* decreased fourfold, and *Proteocephalus percae* appeared. On the other hand, in the case of bream no *Paracoenogonimus ovatus*, *Sphaerostomum maius*, *Sanguinicola* sp., *Phyllodistomum elongatum*, nematode *Philometra ovata* or tapeworm *Ligula intestinalis* were observed, while the prevalence of *Posthodiplostomum cuticola* increased eightfold and that of *Caryophyllaeus laticeps* twofold. The decrease in the number of parasites in rudd could be the consequence of the small number of fish examined.

The absence of *Bunodera lucioperca*, *Phyllodistomum elongatum*, *Sphaerostomum maius* (*Sphaerostomum bramae* according to Niewiadomska 2003), the tapeworm *Ligula intestinalis*, and the nematode *Philometra ovata* indicates the absence of invertebrates that had earlier been present in that lake. The appearance of *Proteocephalus percae* increased the prevalence of *Posthodiplostomum cuticola*, while the appearance of *Caryophyllaeus laticeps* indicate the restoration and diversity of flora and fauna, particularly plankton crustaceans (Moczarska 2003) and benthic oligochaeta (Rozentaliski 2003) as well as fauna of the *Planorbis* family of snails.

This is most likely related to the Lake Kortowskie experiment and the resulting environmental changes as well as advantageous nesting and feeding conditions for piscivorous birds, which are the final hosts for many parasite species with complex developmental cycles.

## CONCLUSIONS

1. The fish parasite fauna of Lake Kortowskie is diversified with respect to its specific composition and quantities. In 2001-2004, 51 species of parasite belonging to dif-

- ferent systematic groups were noted, as follows: Monogenea (27), Digenea (6), Cestoda (7), Nematoda (4), Acanthocephala (3), Crustacea (3), Mollusca (1).
2. Roach and ruffe were the most infected species and prevalence was highest among pike. *Tetraonchus monenteron*, *Triaenophorus nodulosus*, *Ergasilus sieboldi*, and mollusc glochidia occurred in 83.3% of pike. Gudgeon and rudd were the least infected.
  3. The majority of the parasites studied during the current project were non-specific (generalists) and were able to infect almost all fish species inhabiting Lake Kortowskie.
  4. From the comparison of the bream, perch, and rudd infestation parameters of 1984 and 1994 with the current results, it can be concluded, that changes are linked to changes in the environment occurring in Lake Kortowskie as a consequence of the Lake Kortowskie experiment.

## ACKNOWLEDGMENTS

*The paper was prepared with financial support of the European Social Fund and State Budget within the framework of the Integrated Regional Operational Program 2004-2006.*

## REFERENCES

- Bauer O.N. 1987 – *Opredelitel' parasitov presnovodnyh ryb fauny SSSR. Tom 3* – Izdatel'stvo Nauka. Leningrad, 578 p. (in Russian).
- Dzika E. 1987 – Annual occurrence dynamics of common monogeneans on the gills of bream from the Lake Gosławskie (Poland) – *Acta Parasit. Pol.* 32:121-137.
- Dzika E., Dubas J.W. 1988 – The relation between water temperature and the infection intensity of parasites of the genus *Dactylogyrus* infecting bream – *Wiad. Parazytol.* 34: 37-45 (in Polish).
- Dzika E. 2002 – The Parasites of bream *Abramis brama* (L.) from Lake Kortowskie – *Arch. Pol. Fish.* 10: 85-96.
- Gusev A.V. 1985 – *Opredelitel' parasitov presnovodnyh ryb fauny SSSR. Tom 2* – Izdatel'stvo Nauka. Leningrad, 428 p. (in Russian).
- Jańczak J., Brodzińska B., Kowalik A., Sziwa R. 1999 – *Atlas of Polish Lakes III* – IMGW Poznań, Bogucki Wyd. Nauk. 240 p. (in Polish).
- Król T., Ochendowski K. 1988 – Parasitofauna of perch, *Perca fluviatilis* L., from Lake Kortowskie – Master's Thesis, Akademia Rolniczo-Techniczna, Olsztyn (in Polish).
- Kukliński K. 1984 – The state of parasite infection and its impact on the health of bream, *Abramis brama* (L.), from Lake Kortowskie – Master's Thesis, Akademia Rolniczo-Techniczna, Olsztyn (in Polish).

- Lonc E., Złotorzycka J. 1995 – Exercises from parasitology for biology students – Wyd. Uniw. Wroc. 278 p. (in Polish).
- Moczarska I. 2003 – Crustacean plankton (Crustacea) in the littoral zone of Lake Jortowskie – Master's thesis, University of Warmia and Mazury, Olsztyn (in Polish).
- Niewiadomska K. 2003 – Parasites of Polish Fish (an identification key). Trematoda: Digenea – Warszawa PTP, 169 p. (in Polish).
- Pojmańska T., Grabda-Kazubska B., Kazubski S. L., Machalska J. 1980 – Parasite fauna of five fish species from the Konin lakes complex, artificially heated with thermal effluents, and from Gopło Lake – Acta Parasit. Pol. 27:319-357.
- Pojmańska T. 1991 – Parasites of Polish Fish (an identification key). Tapeworms: Cestoda – Instytut Parazytologii im. W. Stefańskiego, PAN, Warszawa, 135 p.
- Rozentali R. 2003 – Chaoborus flavicans (Meigen) of the restored Lake Kortowskie in 1952-2003 – Master's Thesis, University of Warmia and Mazury, Olsztyn (in Polish).
- Waluga J., Chmielewski H. 1996 – Lakes in the vicinity of Olsztyn. A guide by IFI – Wyd. IRS, Olsztyn, 177 p. (in Polish).
- Własow T., Kukliński K., Majewska B., Skork M. 1991 – Parasitofauna of rudd (*Scardinius erythrophthalmus*) and bream (*Abramis brama*) in a lake subjected to oligotrophization – Materiały XVI Zjazdu Polskiego Towarzystwa Parazytologicznego, PTP, Poznań, 34 p. (in Polish).

Received – 05 June 2007

Accepted – 17 October 2007

## STRESZCZENIE

### PASOŻYTY (METAZOA) RYB Z JEZIORA KORTOWSKIEGO

W latach 2001-2004 przeprowadzono badania parazytologiczne ryb z Jeziora Kortowskiego. To eutroficzne jezioro leży w granicach miasta Olsztyna. Od 1959 roku w jeziorze tym przeprowadzany jest eksperyment polegający na usuwaniu wód hipolimnionu. Obecnie zbadano 381 ryb reprezentujących 10 gatunków. Zanotowano 51 gatunków pasożytów należących do: Monogenea (27), Digenea (6), Cestoda (7), Nematoda (4), Acanthocephala (3), Crustacea (3) i Molusca (1). Stwierdzono 6334 pasożyty w badanych rybach, wśród których 3045 to przywry digeniczne. Najwięcej gatunków pasożytów zanotowano u płoci (18), następnie u uklei (14), okonia i krąpia (po 13), leszcza (11), jazgarza i szczupaka (10), a najmniej u kielbia (4) oraz lina i wzdregi (po 2). Porównano i przedyskutowano zarażenie leszcza, okonia i wzdregi w odniesieniu do lat 1984-1988, 1994 i 2001-2003.