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THE PARASITES OF BREAM *ABRAMIS BRAMA* (L.) FROM LAKE KORTOWSKIE

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Abstract. The parasites of bream from the reclaimed Lake Kortowskie were comprised of 16 species belonging to Protozoa, Monogenea, Digenea, Cestoda, Acanthocephala, Nematoda, Crustacea and Molusca. Some parasites were found only on single host specimens (*Trichodina* sp., *Gyrodactylus* sp., *Ichthyocotylurus platycephalus* met., *Glochidium* lar.). The other species (*Dactylogyrus auriculatus*, *Phyllodistomum elongatum*, *Acanthocephalus lucii*, *Philometra* sp.) occurred rarely and with low intensity. A comparative study of the infestation of bream from Lake Kortowskie in the 1984-1994 period indicated that while the number species in the parasite community remained unchanged (16 species), the set of parasites differed distinctly (seven species disappeared and seven others appeared). The frequency of four species, *E. sieboldi*, *Myxobolus* sp., *Trichodina* sp. and *Philometra* sp., decreased, that of *Tylodelphys clavata* increased, while four others, *Gyrodactylus* sp., *Diplostomum* sp., *Caryophyllaeus laticeps*, *Glochidium* lar., occurred at the same level.

Key words: *ABRAMIS BRAMA*, PARASITES, LAKE KORTOWSKIE

INTRODUCTION

The parasites of bream *Abramis brama* L. have been studied in many lakes (Kozicka 1951, 1953, 1971, Grabda and Grabda 1957, Kozicka 1959, Grabda et al., 1961, Wyrzykowska 1964, Grabda 1971, Wierzbicka 1974, Otvodova 1975, Wierzbicka 1977, 1978, Mashtakov 1979, Pojmańska et al. 1980, Pojmańska 1984 a,b, Grabda-Kazubska et al. 1987), thermally polluted reservoirs (Izjumova 1956, Dzika 1987, Pojmańska and Dzika 1987) and rivers (Enayat S.A. Reda 1987).

The first studies of parasites in Lake Kortowskie were carried out in 1983-84 by Kukliński (1984). At the time, the lake was polluted as a result of limited precipitation and a long period during which there had been no water drainage from the hypolimnion. In July, it was clearly overheated and at depths below 8 m only very small amounts of oxygen were detected. Under normal weather conditions, the lake is protected from total degradation by the Olszewski pipeline which permits drainage of benthic and more polluted waters (Mientki, unpublished data). Annual, seasonal studies by the public health authorities indicate that currently the lake water is purity class II and that in spring it is even class I (Endler, personal communication).

The variations of physical and chemical conditions have an impact on the lake's fish and the intensity of their parasite infestation.

The aim of this work was to determine changes which occurred in the parasite infestation of bream in this lake from 1984 to 1994.

MATERIAL AND METHODS

STUDY AREA

Lake Kortowskie is located in northeastern Poland. It has an area of 89.7 ha, an average depth of 5.9 m. and a volume of 5.323×10^6 m^3 (Synowiec 1965). The lake has deep areas in its southern (maximum depth - 17.2 m) and northern parts (maximum depth - 15.7m). A shallow area, with an average depth of about 6.7 m, stretches between the deep areas. The morphometric features and the character of the environment in these areas differs. The northern part of the lake is more exposed to wind than is the southern part (Mientki, personal communication). The lake is eutrophic due to the constant input of sewage. The reservoir is supplied by five inflows. Of these, the Kortówka River used to be the most dangerous for the lake, but in 1989 a sanitary collector was put into operation to clean the water that flows into the lake. Not long ago a similar collector was installed to treat the sewage from the surrounding residential areas which was formerly discharged untreated into the lake (Mientki, personal communication).

The thermal conditions in Lake Kortowskie are impacted by meteorological conditions, morphometric features and, since 1956, the removal of hypolimnion waters via a pipeline (Mientki, unpublished data). The water temperature in Lake Kortowskie at a depth of 1 m as recorded during bream sampling is presented in Fig. 1. It does not vary much to the depth of 5 m, and in summer it exceeded 20°C.

Due to the shape of the bottom, the undifferentiated shoreline and the significant depths and shape of the littoral bottom, the ecosystem of Lake Kortowskie is not highly variable and, as a result, there is a very small degree of floral diversity. Surviving fragments of marshy meadows, which are located around the perimeter of the lake on mineral habitats, stretch along the lake shore and create an intermittent passage of shore tree areas (Polakowski and Dziedzic 1970).

In summer this area is inhabited by many bird species including the grebe (*Podiceps cristatus* L.), mallard (*Anas platyrhynchos* L.), bald coot (*Fulica atra* L.) and lap-

wing (*Vanellus vanellus* L.) and periodically by many migratory species such as the *Larus ridibundus* L., sea-gull (*Larus canus* L.), cormorant (*Phalacrocorax carbo* L.) and kingfisher (*Alcedo atthis* L.) (Nowakowski, unpublished data). The presence of these birds is connected with the occurrence of fish parasites in the water.

STUDY MATERIALS

Bream were caught using gill-nets located in both deep parts of the lake at depths between 3-12 m. Each sample was comprised of between 7 to 18 fish. In 1994, bream were caught in April (18 specimens), May (8 specimens), July (7 specimens), September (15 specimens) and November (7 specimens). In total, 55 bream were examined; they weighed from 110 to 650 g (average - 328 g), their total length ranged from 16 to 39 cm (average of 26.98 cm) and they were aged from 1+ to 4+ years (Table 1).

TABLE 1

Description of the studied bream

Fish age	Number of fish	Total length (cm)			Body weight (g)		
		range	average	(SD)	range	average	(SD)
1+	11	16.0 – 19.0	17.3	± 1.078	37.0 - 52.0	46.0	± 5.75
2+	12	17.5 – 27.5	24.2	± 2.72	54.0 - 215.0	142.5	± 39.75
3+	27	22.0 – 39.0	31.0	± 4.27	110.0 - 650.0	325.0	± 119.84
4+	5	23.5 – 36.0	31.3	± 2.13	355.0 - 549.0	401.8	± 83.56

The fish were either dissected immediately after they were caught or they were refrigerated and dissected within 72 hours. First, a culture was taken from the body surface of fish to test for the presence of protozoa (no culture was taken from the gills). Then the gills were removed and preserved in 4% formaldehyde. Gill parasites were collected from the preserved material (Dzika 1987). Internal parasites were collected and preserved in accordance with the generally accepted methods for particular parasite groups (Pojmańska et al. 1980). An average of 10 specimens were tested in each sample, and a total of 60 bream with a body weight from 89 to 984 g (average weight 324.5 g) and a total length from 22 to 41 cm (average length 31.5 cm) were tested. The following were determined for each parasite species: the extensity of invasion expressed as the percent of infected fish versus the number of fish in the sample; the infestation intensity expressed as the average number of parasites per infested fish; the density of the parasite population in fish populations expressed as the average number of parasites per fish in each sample. The results were compared with those

from ten years before the current study (Kukliński 1984). The extensity figures were used to divide the parasites into the following groups: dominant - occurring in over 50% of the fish, common (10 - 50%), rare (4 - 10%) and sporadic (below 4%) (Pojmańska et al. 1980).

RESULTS

Sixteen parasite species were present in the material studied: two species from the phylum Protozoa, four Monogenea, four Digenea, two Cestoda, one Acanthocephala, one Nematoda, one Crustacea and one Mollusca larvae (Table 2).

TABLE 2

Bream infestation by various parasite species in Lake Kortowskie in 1994

Parasite species	N	E	I	AI	D	N.P
Trichodina sp.	1	1.8	1	1	0.01	1
Myxobolus ellipsoides	14	25.4	1-154	17.6	4.49	247
Dactylogyrus auriculatus	3	5.4	1	1	0.05	3
Dactylogyrus wunderi	5	9.1	1-4	1.8	0.16	9
Dactylogyrus zandti	7	12.7	1-6	2.1	0.27	15
Gyrodactylus sp.	1	1.8	1	1	0.01	1
Diplostomum sp. (met.)	50	90.9	1-157	30.2	27.4	1509
Tylodelphys clavata (met.)	37	67.3	1-97	15.6	10.5	579
Ichthyocotylurus plathycephalus (met.)	1	1.8	1	1	0,018	1
Phyllodistomum elongatum	4	7.2	1-7	3.5	0.25	14
Caryophylaleus laticeps	12	21.8	1-50	16.6	3.6	200
Paradilepis scolecina	15	27.8	1-12	3.9	1.2	58
Acantocephalus lucii	3	5.4	1-6	3.6	0.2	11
Philometra sp.	1	5.4	3	1	0.05	3
Ergasilus sieboldi	12	21.8	1-3	1.6	0.34	19
Glochidium sp.	1	1.8	1	1	0.01	1

N – number of infested fish; E - extensity %; I – intensity; A I – average intensity; D - density; N.P – number of parasites

Of the skin Protozoa, *Myxobolus ellipsoides* was common among 25.4% fish, while *Trichodina* sp. was very sporadic, as only one specimen was found in September.

Dactylogyrus zandti dominated among Monogenea and occurred in 12.7% of the fish at an average intensity of 2.1. *D. wunderi* and *D. auriculatus* occurred more infrequently in 9.1 and 5.4% of the fish, respectively. Single specimens of *D. auriculatus* were found in three fish in April. *Gyrodactylus* sp. was very sporadic with just one specimen noted in July.

The digenean group included three species of metacercariae and one species of mature trematode. Of the former group, *Diplostomum* sp. and *Tylodelphys clavata* dominated and infested 90.9 and 67.3% of the fish with averages of 30.2 and 15.6%, respectively. *Ichthyocotylurus platycephalus* was sporadic. Only one specimen was found in one fish in late April. The trematode *Phyllodistomum elongatum* was sporadic (7.2%) with only 14 specimens found in the urinary tract – seven in the first half of April and seven in September.

The Cestoda class was represented by the species *Caryophyllaeus laticeps* and *Paradilepis scolecina*. The first, as a typical bream parasite, was common in the material studied and infested 21.8% of the fish at an intensity of 16.6. The second, from the family of Dilepididae, was located in the gallbladder and intestines of the bream. A total of 58 specimens of this parasite species was collected throughout the study period. The extent of infestation was 27.8%, and the average intensity was 3.9 specimens per infested fish.

Acanthocephala was represented by one species, *Acanthocephalus lucii,* which occurred sporadically. It was observed only once in three fish in the second part of April. The infestation intensity was 5.4% and the average intensity was 3.6. Of the 11 parasites found, seven were males and four were females.

Nematodes were represented by *Philometra* sp. and occurred rarely (5.4% of the fish) in the body cavities and intestines. Single specimens were noted in the spring and fall in three fish.

Crustacea were represented by *Ergasilus sieboldi* and was common (21.8% of the fish) although the infestation intensity was low at 1.6.

Glochidium larvae from Mollusca were sporadic and were found only once in July.

DISCUSSION

Not all the parasite species observed in 1994 were present in Lake Kortowskie in 1984 (Kukliński 1984; Table 3). No species of the genus Dactylogyrus were observed in the former study, while two species were not observed in the current study, namely *Argulus foliaceus* and *Tracheliastes maculatus.* Changes in the abundance of parasites are clearly visible in the genus Myxobolus which decreased from 80 to 25.4%, while *Ergasilus sieboldi* decreased from 43.3 to 21.8%. Additionally, fewer fish were infested with parasites of the genus Trichodina (6.7 versus 1.8%). The extent of infestation with *Glochidium (*lar.) and *Gyrodactylus* sp. remained on a low level at 1.7 and 1.8%,

respectively. Differences in internal parasites were most notable in trematodes, which were less abundant. Species which were not observed in the current study included *Paracoegonimus ovatus*, (met.), *Posthodiplostomum cuticola*, (met.), *Sanguinicola* sp. and *Sphaerostomum maius*, while newly occurring species included *Phyllodistomum elongatum* and *Ichthyocotylurus platycephalus* (met.). The extent of infestation with *Diplostomum* sp. (met.) was the same as it had been in 1984, while that of *Tylodelphys clavata* (met.) was four-fold higher. Changes were also observed in the Cestoda fauna; *Ligula intestinalis (*pler.*)* was not observed in the current study while *Paradilepis scolecina* appeared. The infestation of *Caryphyllaeus laticeps* was on the similar level to that of the previous study at 26.6 and 21.8%, respectively. Nematode *Philometra* sp. infestation decreased from 13.3 to 5.4%. The acanthocephalon *Acanthocephalus lucii* was observed in the current study.

TABLE 3

Parasites of the bream in Lake Kortowskie in 1984 - 1994

Parasite species	1984 n=60		1994 n=55	
	E	I from-to	E	I from-to
Trichodina sp.	6.7	single	1.8	1
Myxobolus sp.	80		25.4	1-154
Dactylogyrus auriculatus	-	-	5.4	1
Dactylogyrus wunderi	-	-	9.1	1-4
Dactylogyrus zandti	-	-	12.7	1-6
Gyrodactylus sp.	1.7	single	1.8	1
Diplostomum sp. (met.)	88	1-80	90.9	1-157
Tylodelphys clavata (met.)	15	1-8	67.2	1-97
Ichthyocotylurus platycephalus (met.)	-	-	1.8	1
Paracoenogonimus ovatus (met.)	35	1-28	-	-
Posthodiplostomum cuticola (met.)	1.7	0-3	-	-
Sanguinicola sp.	1.7	-	-	-
Sphaerostomum maius	5	1-93	-	-
Phyllodistomum elongatum	-	-	7.2	1-7
Caryophyllaeus laticeps	26.6	1-73	21.8	1-50
*Paradilepis scolecina (*pler.)	-	-	27.8	1-12
Ligula intestinalis (pler.)	8.3	-	-	-
Acanthocephalus lucci	-	-	5.5	1-6
Philometra sp.	13.3	1-4	5.4	0-3
*Ergasilus sieboldd*i	43.3	1-25	21.8	1-3
Tracheliastes maculatus	8.3	1-8	-	-
Argulus foliaceus	5	1-2	-	-
Glochidium (lar.)	1.7	single	1.8	1

E - extensity %; I – intensity; n- number of fish studied

In the current study, differences in infestation were observed in comparison with the 1984 study. Of a total of ten external parasite species five were present in both studies (*Trichodina* sp., *Myxobolus* sp., *Gyrodactylus* sp., *E. sieboldi, Glochidium (*lar.). Two species disappeared (*Argulus foliaceus, Tracheliastes maculatus*), and three new species from the genus Dactylogyrus appeared (D. *auriculatus, D. wunderi, D. zandti*). The frequency of occurrence of *Ergasilus sieboldi* decreased two-fold and that of *Myxobolus ellipsoides* fell three-fold, while *Gyrodactylus* sp. and *Glochdium* (lar.) remained on the same level. Differences were also observed between the current study and that of 1984 with regard to internal parasites. Of the 13 species present, four were noted in both studies (*Diplostomum* sp. (met.*), Tylodelphys clavata (*met.), *Caryophyllaeus laticeps, Philometra* sp.*)*, five disappeared (*Paracoenogonimus ovatus* met., *Posthodiplostomum cuticola (*met.), *Sanguinicola* sp., *Sphaerostomum maius, Ligula intestinalis*, (pler.)), and four new species appeared (*Ichthyocotylurus platycephalus, Phyllodistomum elongatum, Paradilepis scolecina, Acanthocephalus lucii*).

The current extent of *Tylodelphys clavata* occurrence has increased four-fold and that of *Philometra* sp. has decreased two-fold. The remaining two species, *Diplostomum* sp. and *Caryophyllaeus laticeps*, have remained on the same level. Some parasites occurred in one host (*Trichodina* sp., *Gyrodactylus* sp., *Ichthyocotylurus platycephalus* (met.), *Glochidium* (lar.)). *Dactylogyrus auriculatus*, *Phyllodistomum elongatum, Acanthocephalus lucii, Philometra* sp. were rare and the intensity of their occurrence was low. The remaining species exhibited both a higher intensity and extent of infestation (Table 3).

Pojmańska et al. (1980) maintain that long-term thermal pollution influenced changes in the composition and domination structure of Dactylogyrus species in Lake Gosławskie in central Poland. The simple development cycle and short life-span of these parasites (Myxosporidia, Monogenea, Crustacea) (Figs. 1, 2) in combination with their relationship with a single host species also contributes to these changes. Gonzales-Lanza and Alvarez-Pellitero (1982) suggest that the abundance of the parasite population may be affected by abiotic and biotic factors including pH, oxygenation, salinity and trophic level. Variations in these conditions were most probably the reasons for changes in the composition of parasites in bream.

According to some authors, water temperature is one of the principal factors which regulate the population biology of fish parasites, especially external ones (Prost 1957, 1963, Rumjancev 1972). The differences which were observed during the periods of maximum abundance of different species and the results of a few studies of

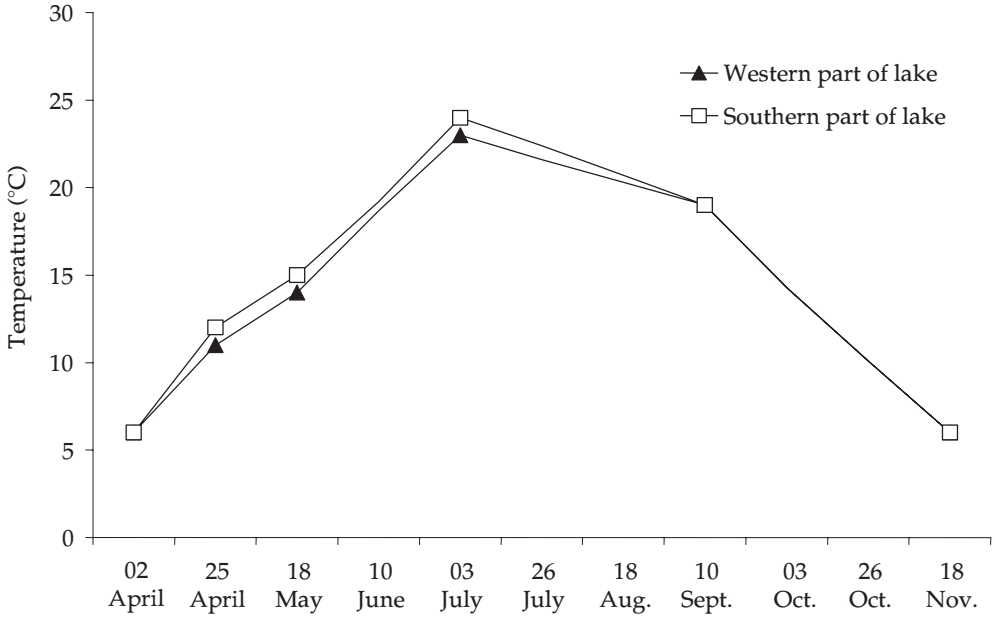

Fig. 1. Water temperature in Lake Kortowskie in 1994 (Mientki, unpublished data).

parasite abundance after infested fish were transferred to different thermal conditions allowed cold-water and warm-water species to be identified and their optimum development temperature to be determined (Kuperman and Shulman 1972). *D. auriculatus* (Strizhak 1972) was classified as a warm-water species, and its optimum development temperature was between 7 and 17°C (Kuperman and Shulman 1978). This species also exhibited a preference for similar water temperatures in Lake Kortowskie as the highest abundance of *D. auriculatus* was observed when the water temperature ranged from 6 - 12°C (Fig. 1, Table 2).

D. wunderi and *D. zandti* are also typically warm-water. Both of these species were more abundant in the heated part of the Ivankovski Reservoir (Strizhak 1972). The results obtained by Pojmańska et al. (1980) differ slightly; in the 1970s they noted a lower level of *D. wunderi* infestation in fish in two of the heated lakes from the Konin system than in the thermally unpolluted Lake Gopło. These species were the most abundant in summer in Lake Kortowskie at temperatures of 19 - 22°C, i.e. at a temperature lower than that in summer in the heated lakes. These temperatures are similar to those regarded as the optimum for the development of these species (Dzika 1987) (Figs. 1, 2B, C).

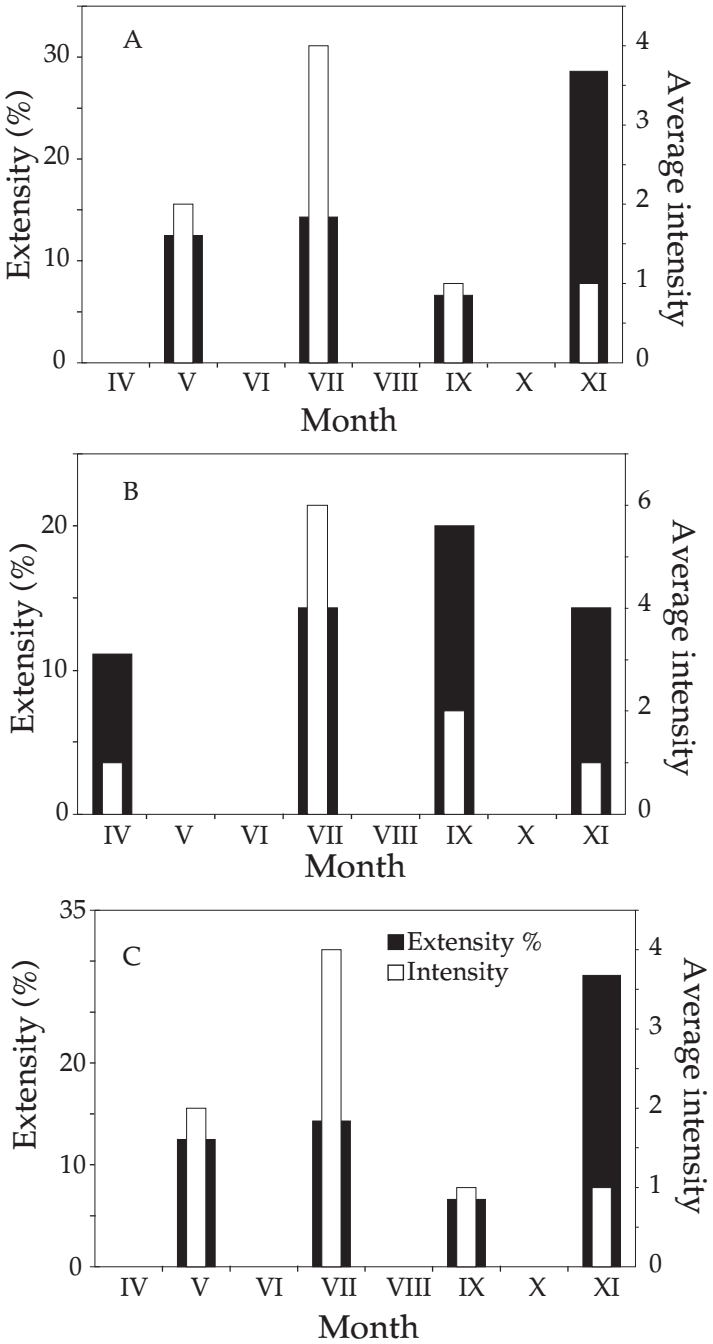

Fig. 2. Dynamics of occurrence: A - *Myxobolus ellipsoides*, B – *Dactylogyrus wunderi*, C – *D. zandti* on bream from Lake Kortowskie.

The effects of temperature on parasites with complex development cycles is intermediate, and it appears that the principal factor which regulates the magnitude of parasite populations is the abundance of intermediary and final hosts (Pojmańska and Dzika 1987).

The increase of the extent of bream infestation with *Tylodelphys clavata* is probably the result of opportune developmental conditions for the snails Radix and Lymnea, which are the intermediary hosts for this parasite. Over the last two years a higher temperature was observed at the depth in which bream feed (Własow, personal communication). A similar increase of the extent of bream infestation with *T. clavata* was observed by Pojmańska et al. (1980) in Lake Licheńskie, which is one of the warmest lakes in the Konin complex. Increased temperature could have a converse impact on the decrease of fish infestation with *Philometra ovata* by reducing the intermediary host (feeding Cyclopidae) for this parasite species. The appearance of *Ichthyocotylurus platycephalus* and *Phyllodistomum elongatum* is related to the diverse fauna of the littoral, where a rapid increase in the abundance of intermediary hosts was observed and included molluscs Anodonta and snails *Valvata piscinalis* (Widuto, personal communication).

The appearance of *Paradilepis scolecina* in bream may be connected to changes in the lake's environment and the appearance of intermediary hosts, such as Copepoda, which are particular to this parasite (Pojmańska 1991).

The occurrence of *Paradilepis scolecina*, *Phyllodistomum elongatum*, *Ichthyocotylurus platycephalus*, and *Acanthocephalus lucii* and an increase of the abundance of metacercariae *Tylodelphys clavata* may indicate the diversity and recovery of invertebrate fauna. This is most likely related to the "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.

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STRESZCZENIE

PARAZYTOFAUNA LESZCZA *ABRAMIS BRAMA* (L.) Z JEZIORA KORTOWSKIEGO

Parazytofauna leszcza z rekultywowanego Jeziora Kortowskiego składała się z 16 gatunków pasożytów należących do Protozoa, Monogenea, Digenea, Cestoda, Acanthocephala, Nematoda, Crustacea, Molusca (tab. 1, 2). Niektóre z nich występowały tylko na jednym osobniku żywicielskim (*Trichodina* sp., *Gyrodactylus* sp., *Ichthyocotylurus platycephalus* met., *Glochidium* lar.). *Dactylogyrus auriculatus, Phyllodistomum elongatum, Acanthocephalus lucii, Philometra* sp. występowały rzadko i z niską intensywnością. Pozostałe gatunki wykazywały wyższą ekstensywność i intensywność zarażenia. Zarażenie leszcza w latach 1984-1994 uległo istotnym zmianom: wśród 16 gatunków pasożytów 7 zniknęło, a na ich miejsce pojawiło się 7 nowych (tab. 3). Częstotliwość występowania czterech *(E. sieboldi, Myxobolus* sp., *Trichodina* sp., *Philometra* sp.) zmalała, podczas gdy jednego *Tylodelphys clavata* wzrosła, a tylko czterech pozostałych *(Gyrodactylus* sp., *Diplostomum* sp., *Caryophylleus laticeps*, *Glochidium* lar.) była na tym samym poziomie.

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