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## Metazoan parasites of fish species from Lake Sığircı (Edirne, Turkey)

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**Abstract:** A total of 366 specimens of 10 fish species inhabiting Lake Sığircı were examined between April 2009 and February 2010. Inside or outside of these fish, 33 parasite species were identified. From these parasites, 18 monogenean, 5 digenean trematode, 3 cestode, 3 acanthocephalan, 3 nematode, and 1 Mollusca: Bivalvia (glochidia) species were recorded. *Diplostomum* spp., *Tylodelphys clavata*, glochidia-larvae, and monogenean species were found to be common parasites in all the fish species examined. The highest prevalence and mean infection intensity with *Diplostomum* spp. were found in *Lepomis gibbosus* (prevalence 91.6%, mean intensity 5.6 individuals per fish) and in *Scardinius erythrophthalmus* (prevalence 88.0%, mean intensity 73.0 individuals); *Tylodelphys clavata* occurred with the highest prevalence (98.2%) and mean infection intensity (181.3 individuals) in *Perca fluviatilis*. *Carassius gibelio* exhibited rich monogenean biodiversity, with 6 species.

**Key words:** Lake Sığircı, fish, metazoan parasites

### 1. Introduction

Lake Sığircı was constructed in 1990 as a water source for rice fields (1). The lake has a surface area of 6.5 km<sup>2</sup> and it is under the influence of the floodwater of the Meriç River. Lake Gala, situated 4 km south of the lake, has been registered as a protected wetland; all of the area is on the route of migrant birds and it is a breeding site for native and migrant birds. The lake has succumbed to negative influence from chemical fertilizers derived from the surrounding paddy fields and is considered eutrophic. These characteristics of Lake Sığircı have an effect on the parasitic fauna of the fish living in it. Andrews (2), after examining the parasitic fauna of perch, mentioned that the parasitic fauna of fish was influenced by the diversity and the abundance of the local aquatic invertebrate fauna, the local ichthyofauna, the piscivorous avian fauna, and the history and geographic isolation of the environment. There has been no study on aquatic invertebrate fauna, or the fish species and their parasitic fauna, in the lake. This study is the first parasitological research survey of the fish in the lake.

The main aim of the present study is elucidation of the metazoan parasites of the fish from the lake.

### 2. Materials and methods

The fish specimens were taken from Lake Sığircı (40°49'39"N, 26°19'30"E), from April 2009 to February 2010. Fish samples were collected 4 times, in April, July,

October, and February, as seasonal catches from local fishermen. In total, 366 fish host species were examined: 93 roach (*Rutilus rutilus*), 78 gibel carp (*Carassius gibelio*), 56 rudd (*Scardinius erythrophthalmus*), 25 common carp (*Cyprinus carpio*), 52 perch (*Perca fluviatilis*), 14 zander (*Sander lucioperca*), 32 pumpkinseed sunfish (*Lepomis gibbosus*), 5 European eel (*Anguilla anguilla*), 3 pike (*Esox lucius*), and 8 European catfish (*Silurus glanis*). The fish specimens were transported to the laboratory alive, where they were all weighed and measured and their sex was determined. Dissection of the fish specimens was done within 2 days. During the dissection, the body cavity, all internal organs, the gills, the eyes (lens and vitreous humor), the skin, and the fins were examined. Isolated parasites were fixed and preserved according to the methods of Bylund et al. (3). Identification of parasites was made according to Niewiadomska and Laskowski (4), Scholz et al. (5), Pugachev et al. (6), and Bykhovskaya-Pavlovskaya et al. (7).

### 3. Results

The parasites and their fish hosts were recorded during the examination of 366 fish samples from 10 fish species, and they are shown in Table 1. The number of fish species examined and the recorded number of parasite species are shown in Table 2. The distribution of parasites according to systematic groups is given in Table 3.

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**Table 1.** Parasite species and their fish hosts recorded in Lake Sığircı.

Parasite species	Fish hosts
<b>METAZOA</b>	
Platyhelminthes	
<b>Monogenea</b>	
DACTYLOGYRIDAE	
<i>Dactylogyrus crucifer</i> Wagener, 1857	<i>Rutilus rutilus</i>
<i>Dactylogyrus sphyrna</i> Linstow, 1878	<i>Rutilus rutilus</i>
<i>Dactylogyrus difformis</i> Wagener, 1857	<i>Scardinius erythrophthalmus</i>
<i>Dactylogyrus difformoides</i> Glaser and Gussev, 1967	<i>Scardinius erythrophthalmus</i>
<i>Dactylogyrus anchoratus</i> Dujardin, 1845	<i>Carassius gibelio</i>
<i>Dactylogyrus vastator</i> Nybelin, 1924	<i>Carassius gibelio</i>
<i>Dactylogyrus baueri</i> Gussev, 1955	<i>Carassius gibelio</i>
<i>Dactylogyrus inexpectatus</i> Izjumova, 1955	<i>Carassius gibelio</i>
<i>Dactylogyrus extensus</i> Mueller and Van Cleave, 1932	<i>Cyprinus carpio</i>
ANCYROCEPHALIDAE	
<i>Silurodiscooides vistulensis</i> Gussev, 1985	<i>Silurus glanis</i>
<i>Silurodiscooides siluri</i> Gussev, 1976	<i>Silurus glanis</i>
<i>Onchocleidus similis</i> Mueller, 1936	<i>Lepomis gibbosus</i>
<i>Ancyrocephalus paradoxus</i> Creplin, 1839	<i>Sander lucioperca</i>
PSEUDODACTYLOGYRIDAE	
<i>Pseudodactylogyrus anguillae</i> Yin and Sproston, 1948	<i>Anguilla anguilla</i>
<i>Pseudodactylogyrus bini</i> Kikuchi, 1929	<i>Anguilla anguilla</i>
TETRAONCHIDAE	
<i>Tetraonchus monenteron</i> Diesing, 1858	<i>Esox lucius</i>
GYRODACTYLIDAE	
<i>Gyrodactylus</i> spp.	<i>Perca fluviatilis</i> , <i>Cyprinus carpio</i> , <i>Carassius gibelio</i> , <i>Sander lucioperca</i> , <i>Lepomis gibbosus</i>
DIPLOZOIDAE	
<i>Paradiplozoon</i> sp.	<i>Cyprinus carpio</i>
<b>Cestoda</b>	
CARYOPHYLLAEIDAE	
<i>Caryophyllaeus fimbriceps</i> Annenkova-Khlopina, 1919	<i>Cyprinus carpio</i>
BOTHRIOCEPHALIDAE	
<i>Bothriocephalus acheilognathi</i> Yamaguti, 1934	<i>Cyprinus carpio</i>
PROTEOCEPHALIDAE	
<i>Proteocephalus percae</i> Müller, 1780	<i>Perca fluviatilis</i> , <i>Sander lucioperca</i>
<b>Digenea</b>	
STRIGEIDAE	
<i>Tetracotyl</i> spp.	<i>Perca fluviatilis</i> , <i>Sander lucioperca</i> , <i>Lepomis gibbosus</i>
DIPLOSTOMIDAE	
<i>Diplostomum</i> spp.	<i>Perca fluviatilis</i> , <i>Cyprinus carpio</i> , <i>Carassius gibelio</i> , <i>Sander lucioperca</i> , <i>Lepomis gibbosus</i> , <i>Scardinius erythrophthalmus</i> , <i>Rutilus rutilus</i> , <i>Esox lucius</i> , <i>Silurus glanis</i>
<i>Posthodiplostomum cuticola</i> Nordman, 1832	<i>Scardinius erythrophthalmus</i>
<i>Tylodelphys clavata</i> Nordmann, 1832	<i>Perca fluviatilis</i> , <i>Scardinius erythrophthalmus</i> , <i>Sander lucioperca</i> , <i>Cyprinus carpio</i> , <i>Lepomis gibbosus</i> , <i>Rutilus rutilus</i> , <i>Esox lucius</i> , <i>Silurus glanis</i>
CLINOSTOMATIDAE	
<i>Clinostomum complanatum</i> Rudolphi, 1814	<i>Scardinius erythrophthalmus</i> , <i>Perca fluviatilis</i> , <i>Cyprinus carpio</i> , <i>Sander lucioperca</i> , <i>Lepomis gibbosus</i>
<b>Acanthocephala</b>	
NEOECHINORHYNCHIDAE	
<i>Neoechinorhynchus</i> sp.	<i>Cyprinus carpio</i> , <i>Esox lucius</i>

**Table 1.** (Continued).

ECHINORHYNCHIDAE	
<i>Acanthocephalus anguillae</i> (Müller, 1780)	<i>Anguilla anguilla</i>
<i>Acanthocephalus lucii</i> (Müller, 1777)	<i>Anguilla anguilla</i>
Nemathelminthes	
<b>Nematoda</b>	
DIOCTOPHYMATIDAE	
<i>Eustrongylides excisus</i> Jagerskiöld, 1909	<i>Perca fluviatilis</i> , <i>Sander lucioperca</i>
DRACUNCULIDAE	
<i>Anguillicoloides crassus</i> Kuwahara, Niimi & Itagaki, 1974	<i>Anguilla anguilla</i>
Nematoda gen. sp.	<i>Esox lucius</i> , <i>Silurus glanis</i>
<b>Mollusca</b>	
Bivalvia	
UNIONIDAE	
Glochidia larvae	<i>Scardinius erythrophthalmus</i> , <i>Perca fluviatilis</i> , <i>Cyprinus carpio</i> , <i>Sander lucioperca</i> , <i>Lepomis gibbosus</i> , <i>Rutilus rutilus</i> , <i>Esox lucius</i> , <i>Silurus glanis</i>

**Table 2.** Number of fish examined and their parasite species in Lake Sığircı.

Fish	Number of fish examined	Number of parasite species
<i>Rutilus rutilus</i>	93	5
<i>Carassius gibelio</i>	78	7
<i>Scardinius erythrophthalmus</i>	56	7
<i>Perca fluviatilis</i>	52	8
<i>Lepomis gibbosus</i>	32	8
<i>Cyprinus carpio</i>	25	9
<i>Sander lucioperca</i>	14	9
<i>Silurus glanis</i>	8	5
<i>Anguilla anguilla</i>	5	4
<i>Esox lucius</i>	3	5

**Table 3.** Distribution of fish parasites in Lake Sığircı according to systematic group.

Systematic group of parasite	Number of species
Monogenea	18
Digenea	5
Cestoda	3
Acanthocephala	3
Nematoda	3
Mollusca	1

*Diplostomum* spp., *Tylodelphys clavata*, glochidia larvae, and monogenean species were found to be common parasites, except glochidia for *Carassius gibelio*.

Metacercariae of *Diplostomum* spp. were recorded in all fish hosts examined, except for *Anguilla anguilla*. *Diplostomum* spp. were found in the lenses of the eyes of the fish; species identification of the parasites in this genus was difficult and for this reason only the genus name is used. Metacercariae of the parasites, found in the vitreous humor, were identified as *Tylodelphys clavata*. The prevalence of *Diplostomum* spp. was high in all fish species, except for gibel carp where there was a lower prevalence (13.0%). The highest prevalence and mean infection intensity of *Diplostomum* spp. were recorded in rudd as 88.0% and 73 individuals per fish, respectively (Table 4). The prevalence of *Tylodelphys clavata* ranged from 0% in gibel carp to 98.2% in perch. High mean infection intensities were recorded in perch (181.3 individuals per fish; Table 4). Metacercariae of *Posthodiplostomum cuticola*

**Table 4.** Common parasite species of the fish from Lake Sığirci: prevalence (P) (%) and mean intensity (M.I.) of parasitic infections.

Parasites	<i>Scardinius erythrophthalmus</i>		<i>Perca fluviatilis</i>		<i>Cyprinus carpio</i>		<i>Carassius gibelio</i>		<i>Sander lucioperca</i>		<i>Lepomis gibbosus</i>		<i>Rutilus rutilus</i>		<i>Esox lucius</i>		<i>Silurus glanis</i>		<i>Anguilla anguilla</i>	
	P (%)	M.I.	P (%)	M.I.	P (%)	M.I.	P (%)	M.I.	P (%)	M.I.	P (%)	M.I.	P (%)	M.I.	P (%)	M.I.	P (%)	M.I.	P (%)	M.I.
<i>Diplostomum</i> spp.	88.0	73.0	70.0	6.0	70.8	6.4	13.0	4.1	81.8	16.2	91.6	5.6	77.6	52.3	33.3	5.0	62.5	3.2	-	-
<i>Tylolephys clavata</i>	58.3	57.8	98.2	181.3	23.0	3.3	-	-	63.6	49.9	75.0	7.4	42.7	38.1	66.6	15.6	37.5	7.3	-	-
Monogenea	58.3	-	7.8	-	85.7	-	51.5	-	34.1	-	63.6	-	82.6	-	100	23.0	87.5	18.3	100	21.3
<i>Posthodiplostomum cuticola</i>	18.2	8.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Caryophyllaeus fimbriiceps</i>	-	-	-	-	27.3	9.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Bothriocephalus acheilognathi</i>	-	-	-	-	18.2	1.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Eustrongylides excisus</i>	-	-	95.1	46.2	-	-	-	-	91.6	18.4	-	-	-	-	-	-	-	-	-	-
<i>Anguillicoloides crassus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	42.5	4.2
<i>Neoechinorhynchus</i> sp.	-	-	-	-	9.1	1.0	-	-	-	-	-	-	-	-	33.3	2.0	-	-	-	-
<i>Acanthocephalus anguillae</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	33.3	1.3
<i>Tetracotyl</i> sp.	-	-	3.9	0.8	-	-	-	-	25.0	9.8	16.6	-	-	-	-	-	-	-	-	-
<i>Clinostomum complanatum</i>	-	-	13.1	2.8	-	-	-	-	8.3	1.0	8.3	1.0	-	-	-	-	-	-	-	-
<i>Proteocephalus percae</i>	-	-	53.5	27.7	-	-	-	-	25.0	17.2	-	-	-	-	-	-	-	-	-	-
Glochidia	11.1	-	26.6	-	18.2	-	-	-	33.3	-	33.3	-	28.3	18.7	100	-	62.5	9.2	-	-

were recorded only on the skin, the fins, and the gill arches of rudd. Overall, monogenean species prevalence was 82.6% in roach, 50.0% in rudd, 7.8% in perch, 85.7% in common carp, 51.5% in gibel carp, 30.8% in zander, and 63.6% in pumpkinseed sunfish. *Dactylogyrus crucifer*, *D. anchoratus*, *D. sphyrna*, and *D. vastator* are known as monogeneans that are not host-specific; all other monogenean species are host-specific. Gibel carp exhibited a rich monogenean biodiversity, with *D. anchoratus*, *D. vastator*, *D. baueri*, *D. inexpectatus*, *D. extensus*, and *Gyrodactylus* sp. *Caryophyllaeus fimbriceps* was recorded only in common carp, *Proteocephalus percae* infected perch and zander, and *Bothriocephalus acheilognathi* was found only in common carp (Table 1).

#### 4. Discussion

This study provides the first research data on parasitic fauna of fish species from Lake Sığircı. The fish specimens examined belonged to 6 families: *Scardinius erythrophthalmus*, *Rutilus rutilus*, *Cyprinus carpio*, and *Carassius gibelio* to Cyprinidae; *Perca fluviatilis* and *Sander lucioperca* to Percidae; *Lepomis gibbosus* to Centrarchidae; *Esox lucius* to Esocidae; *Silurus glanis* to Siluridae; and *Anguilla anguilla* to Anguillidae. Of these fish species, *C. gibelio*, *S. lucioperca*, and *L. gibbosus* are alien species. *C. gibelio* is known as one of the most hazardous fish species for native fish fauna (8). *C. gibelio* can be a powerful invader when it is introduced into new ecosystems; for example, this species has invaded some freshwater resources in Thrace (9). *S. lucioperca* was introduced to Lake Eğirdir in 1955 and then it was spread to other lakes of Turkey (10). *L. gibbosus* was recorded first by Erk'akan (11) in Thrace, the region in which Lake Sığircı is located. Along with the introduction of alien fish species, their parasites also invaded (12). For this reason, some parasite species like *Dactylogyrus extensus*, *D. vastator*, *D. baueri*, *D. anchoratus*, *D. inexpectatus*, *Onchocleidus similis*, *Pseudodactylogyrus anguillae*, *P. bini*, *Bothriocephalus acheilognathi*, *Anguillicoloides crassus*, and *Clinostomum complanatum* are also alien parasitic species.

Metacercariae of *Diplostomum* spp., *Tylodelphys clavata*, glochidia-larvae, and monogenean species were recorded in most of the fish specimens examined.

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Gastropods, especially lymnaeid snails, which are the first intermediate hosts of eye-flukes *Diplostomum* spp. and *T. clavata*, were present in the lake; however, their definitive hosts are piscivorous birds of various groups (4). *Pelecanus onocrotalus* and other piscivorous birds like *Cygnus olor*, *Phalacrocorax pygmeus*, *Egretta garzetta*, and *Ardea cinerea* were also present in the lake. Species identification of *Diplostomum* metacercariae has been difficult, since their morphology exhibit some similarities (13) and strong host specificity is rare. In addition, one fish specimen might harbor several *Diplostomum* species (4); for these reasons, only the genus name is used.

Most of the parasites had a high degree of host specificity and infected a single fish host (Table 1). *D. extensus* was recorded on the gills of *Carassius gibelio* 2 times; this monogenean is known as host-specific for *Cyprinus carpio* (14). Shamsi et al. (15) recorded *D. extensus* on *Carassius gibelio* and our findings were similar. *C. gibelio* was found to have the highest monogenean species richness, with 6 species.

In conclusion, based on the occurrence of parasite species in fish specimens from Lake Sığircı, some parasite species showed host specificity (11 monogenean species). Of the total number of parasites, 21 parasite species had indirect life cycles provided that adequate intermediate host species were present in the lake. As invasive fish species invade a new area, they bring with them their parasites; 8 monogeneans, 1 cestode, 1 nematode, and 1 digenean parasite species were qualified in this category for the lake. Fish parasites from Lake Sığircı showed high species richness, but it was difficult to estimate the total number of parasite species in fish specimens from the lake. Some fish species were not examined and some fish species were examined in a limited number. This is an initial study and a long-term research survey is needed.

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