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Metazoan Parasites of Perch *Perca fluviatilis* L. From Lake Sığırcı, Ipsala, Turkey

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Abstract.- There has been no previous parasitological survey of perch *Perca fluviatilis* in Turkey. Consequently, the objectives of the present study were to investigate the metazoan parasite communities of perch and also to calculate infection parameters of the parasites in a eutrophic lake. A total of 52 perch were collected seasonally from Lake Sığırcı in Ipsala, Turkey, between April 2009 and February 2010. *Perca fluviatilis* specimens were parasitized by eight species. The parasite prevalence and mean intensity (MI), respectively, for the whole material were: *Gyrodactylus* sp., 5.8%, MI (± SD) 2.6 ± 0.57; *Diplostomum* sp., 71.1%, MI 6.2 ± 4.64; *Tylodelphys clavata*, 98.1%, MI 175.7 ± 62.64; *Tetracotyle* sp., 3.9%, MI 1.5 ± 0.70; *Clinostomum complanatum*, 15.4%, MI 3.5 ± 4.40; *Proteocephalus percae*, 55.7%, MI 47.10 ± 55.67; *Eustrongylides excisus*, 94.2%, MI 42.2 ± 62.89; *Glochidium* sp., 30.8%, MI 23.5 ± 27.42. From the current results it can be concluded that, in perch from Lake Sığırcı, *T. clavata*, *E. excisus*, *Diplostomum* sp. and *P. percae* are the most prevalent parasite species.

Key words: Metazoan parasites, perch, Lake Sığırcı, Turkey.

INTRODUCTION

Turkey has more than 120 natural lakes and 656 dam lakes and reservoirs (Anonymous, 2009). There are 236 fish species and subspecies belonging to 26 families that live in Turkish inland waters (Kuru, 2004). Lake Sığırcı is one of these freshwater environments, being located 13 km south of Ipsala County in Edirne province and 1 km west of Yeni Karpuzlu Town. The lake was constructed for the irrigation of rice paddy and has a holding capacity of 50.67 hm^3 (40° 49' 39" N, 26° 19' 30" E). The lake is under protection as a wetland and it a breeding area of native and immigrant birds. The lake is eutrophic in character and subject to negative influence from chemical fertilizers running off the surrounding paddy fields. Previously, there has been no study on invertebrate species, the fish species and their parasite fauna in this lake. To date, also, there has been no detailed study on the parasites of perch (*Perca fluviatilis*) in Turkey. *Perca fluviatilis* has been recorded in the inland waters of Marmara, and in the west and middle parts of the Black Sea region of Turkey (Geldiay and Balık, 1988).

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MATERIALS AND METHODS

A total of 52 *Perca fluviatilis* specimens (33 male and 19 female) with a mean (± SD) total length of 21.5±2.8 cm (range 13.0–31.4 cm) and a mean total weight of 151.9±55.8 g (range 27.6–353.5 g) were examined four times (April, July and October 2009 and February 2010). All the fish were caught by local fishermen and carried alive to the laboratory in lake water, and then each specimen was anesthesied with tricaine methanesulfonate (MS-222) and total length, weight and sex were recorded. The fish were examined under a stereomicroscope (10X, 20X) for the presence of metazoan parasites according to Bylund *et al*. (1980). Cestod and digenean specimens were fixed in Bouin's fluid under coverslip pressure and then cleared in lithium carbonate, stained with aceto-carmin, dehydrated with alcohol series and mounted in Canada balsam. Nematodes were killed in glacial acetic acid and fixed in 70% alcohol cleared in lactophenol. The monogenean parasites were removed and placed on a slide with ammonium picrate-glycerin or lactophenol, covered with a cover-glass and flat mounts were prepared. Prevalence, mean intensity and mean abundance were calculated according to Bush *et al*. (1997). Preparation of the slides was performed according

to Bylund *et al*. (1980). The parasite specimens were identified according to Bykhovskaya-Pavlovskaya *et al*. (1962), Gussev (1985), Moravec (1994), Scholz *et al*. (1998). Data were analyzed with the software packages Microsoft SPSS version 16.0 for statistical evaluation. The differences of the parasite number between the left and right sides and between seasons were tested using the Mann–Whitney *U* test. Parasite species with greater than 50% prevalence were considered core species, those with prevalence of < 50% but > 10% as secondary species. Satellite species were occurring at a prevalence of less than 10%.

RESULTS

All the perch were found to be parasitized; the eight metazoan parasite species that infected the fish included one monogenean (*Gyrodactylus* sp.), four digenean (*Diplostomum* sp. metacercariae, *Tylodelphys clavata* metacercariae, *Tetracotyle* sp., *Clinostomum complanatum* metacercariae), one cestode (*Proteocephalus percae*), one nematode (*Eustrongylides excises* larvae) and one mollusc (*Glochidium* sp.). *T. clavata*, *E. excisus*, *Diplostomum* sp. and *Proteocephalus percae*, occurred in the majority of the fish that we examined as common parasites. The prevalence, mean intensity and mean abundance of the infections with the eight parasite species and their site of infection are given in Table I. A total of 52 perch were examined, six of which (11.5%) were infected with two parasite species, 16 (30.8%) with three, 18 (34.6%) with four, 11 (21.2%) with five and one (1.9%) with six parasite species (Fig. 1).

In total, 8962 *T. clavata* were recorded: 4524 individual parasites from left eyes and 4438 parasites from right eyes. The difference was not significant between the number of *T. clavata* found in the left and right eyes (Mann–Whitney *U* test: Z = –0.664, *P*=0.507, *P*>0.05). The prevalence of this parasite was 100% in spring, autumn and winter, slightly decreasing to 92.8% in summer (Fig. 2). The mean intensity of *T. clavata* was at its highest in summer (308.5 individuals), decreasing to 85.0 in spring (Fig. 3). The maximum intensity of infection was 1146 specimens of *T. clavata* in summer in a single fish.

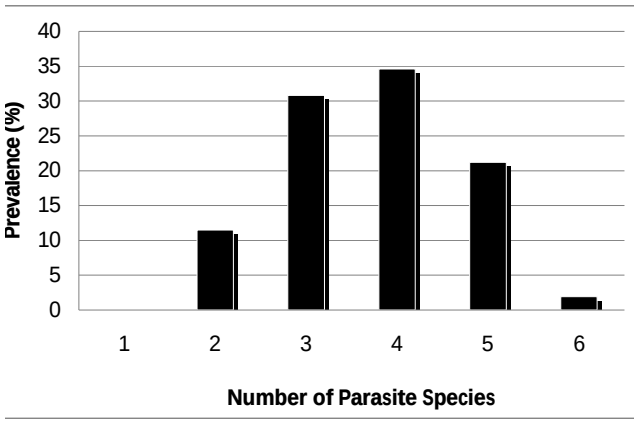

Fig. 1. Prevalence of the fish and their number of parasite species.

The prevalence of the second most common parasite (*E. excisus*) was 100% in autumn and winter, decreasing in spring to 87.5% (Fig. 2). In total, 2070 *E. excisus* individuals were recorded. The mean intensity of *E. excisus* was found at its maximum in autumn (106.1), decreasing to 17.6 individuals in spring (Fig. 3). The maximum number of *E. excisus* was recorded as 305 individuals in one host specimen. *E. excisus* capsulated larvae were found generally in abdominal muscle and in the mesentery of the intestinal wall.

The third most common parasite (*Proteocephalus percae*) found totalled 1366 individuals. *Proteocephalus percae* was recorded at its maximum in spring (100%), decreasing to 0% in autumn (Fig. 2). The mean intensity of *Proteocephalus percae* was maximum in spring, with 55.8 individual parasites. The difference was significant between the number of *Proteocephalus percae* found in summer–autumn and winter–spring (Mann–Whitney *U* test: Z = –0.033, *P*=0.03, *P*<0.05).

In total, 376 individuals of *Glochidium* sp. were recorded; the maximum percentage was found in autumn (50.0%), and the minimum in winter (8.3%). The maximum mean intensity of *Glochidium* sp. was recorded in summer as 30.4 individuals.

A total of 235 individuals of *Diplostomum* sp., 123 from left and 112 from right eyes, was recorded and no significant differences were found

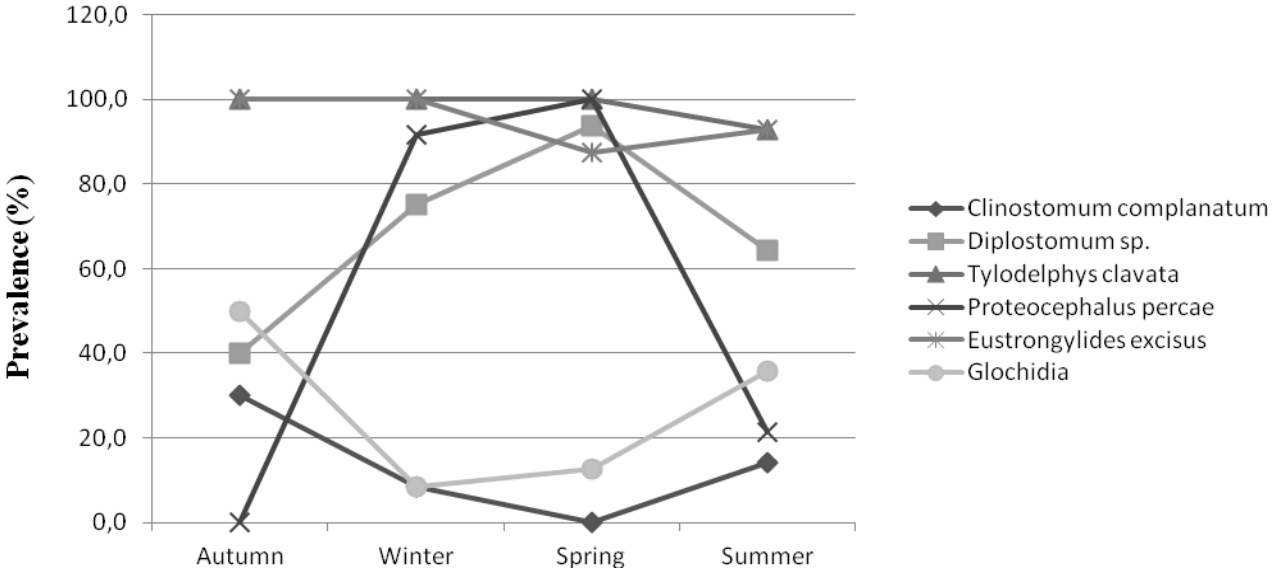

Fig. 2. Seasonal prevalence of common parasite species of perch (*Perca fluviatilis*) in Lake Sığırcı.

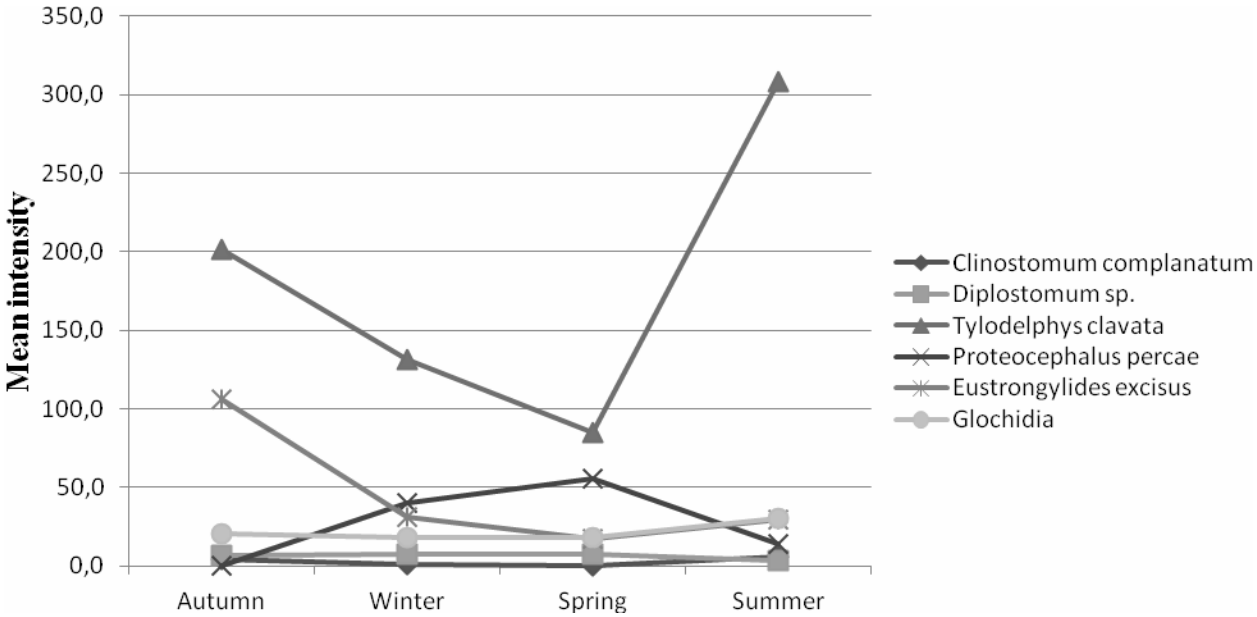

Fig. 3. Seasonal mean intensity of common parasite species of perch (*Perca fluviatilis*) in Lake Sığırcı.

(Mann–Whitney *U* test: Z = –0.340, *P*=0.557, *P*>0.05). The maximum prevalence of *Diplostomum* spp. was recorded (93.8%) in spring and the minimum (40.0%) in autumn (Fig. 2). The mean intensity of *Diplostomum* sp. was found to be rather low (6.2 individuals) when compared with its prevalence (Table I).

The other three parasite species, namely *C. complanatum*, *Gyrodactylus* sp. and *Tetracotyle* sp., were recorded rarely and their total numbers found were 27, eight and three, respectively. *C. complanatum* was found at its maximum both in summer and autumn; the difference was significant between the numbers of *C. complanatum* found in

Table I.- The prevalence, mean intensity and abundance of parasites in perch (*Perca fluviatilis*) from Lake Sığırcı (*n* = 52).

Parasite	Infested fish number	Prevalence (%)	Mean intensity	Range	Abundance	Site of infection
Tylodelphys clavata	51	98.0	175.7	3–1146	172.30	Humour of eye
Eustrongylides excisus	49	94.2	42.2	1–305	39.80	Intestine, the muscles
Diplostomum sp.	37	71.1	6.2	2–28	4.38	Lens of eye
Proteocephalus percae	29	55.7	55.8	1–251	31.10	Lumen of intestine
Glochidium sp.	16	30.8	23.5	1–124	7.20	Gill, fins
Clinostomum complanatum	8	15.4	2.5	1–12	0.33	Operculum, gills
Gyrodactylus sp.	3	5.8	2.6	2–3	0.15	Skin, fins
Tetracotyle sp.	2	3.9	1.5	1–2	0.06	Pericardium

summer–autumn and winter–spring (Mann–Whitney *U* test: Z = –0.02, *P*=0.015, *P*<0.05). No dactylogyrid monogenean was recorded, but *Gyrodactylus* sp. was found sporadically on the gill arches of two fishes in spring and one fish in winter. The prevalence, mean intensity and mean abundance of parasites in *Perca fluviatilis* are shown in (Table I).

DISCUSSION

Five parasite species of perch in Lake Sığırcı complete their life cycles in bird hosts. The characteristics of the composition of the metazoan parasites of perch in this lake can generally be explained by the special features of the environment. The lake and near surroundings are a breeding area, especially for immigrant birds; this provides hosts to complete the life cycles of the digenean and nematod parasites of perch.

T. clavata has been recorded by some authors in Turkey, especially from cyprinid fish, and with a low intensity (Soylu, 2006; Akbeniz and Soylu, 2010). In the present study, the prevalence, intensity and abundance of *T. clavata* were found to be higher than in the previous studies. Pojmanska *et al*. (1980) remarked that *T. clavata* mostly infected Percidae, mainly perch. Morozinska-Gogol (2007) found that *T. clavata* occurred with the highest mean intensity in perch compared with other fish species from Lebsko Lagoon. Shukerova *et al*. (2010) found *T. clavata* as dominant parasite species of the perch component community. All these suggestions are in agreement with our findings. *T. clavata* do not accumulate in the host eyes and their life time is shorter than a year (Niewiadomska, 1972). *T. clavata* does not cause injury to the fish host differently from *Diplostomum* sp. Kennedy (1984), but both the prevalence and mean intensity of *T. clavata* were found to be highly excessive in the present study.

The overall prevalence (94.2%) and mean intensity (42.2) of *E. excisus* reduce the economic value of perch in Lake Sığırcı, because *E. excisus* capsulated larvae were found generally in abdominal muscle and in the mesentery of the intestinal wall of the perch. *E. excisus* larvae occur mainly in the musculature of predatory fishes, mainly perch, and *E. excisus* larvae are highly pathogenic for fish. The first intermediate hosts of *E. excisus* are aquatic oligochaetes such as *Lumbriculus*, *Tubifex* and *Limnodrilus* species (Karmanova, 1965). Perch may act in the nematod development as either the second intermediate or paratenic host. Shukerova *et al*. (2010) have recorded four nematode species (*Contracaecum microcephalum, Eustrongilides excisus, E. tubifex* and *Rhaphidascaris acus*) in perch. Some fish-eating birds, such as pelicans (*Pelecanus* sp.) and cormorants (*Phalacrocorax* sp.), are definitive hosts (Seyda, 1973). The occurence of *Eustrongylides* larvae in fishes is mainly found in lakes and reservoirs, which are suitable environments for the invertebrate and definitive hosts (Moravec, 1994). From this point of view, Lake Sığırcı is a suitable environment for *E. excisus* infections; pelican (*Pelecanus onocrotalus*) herds were seen year-round with other piscivorous birds like *Cygnus olor, Phalacrocorax pygmeus, Egretta garzetta* and *Ardea cinerea* during the present study. Soylu (2005), Karatoy and Soylu (2006) and Öztürk *et al*. (2001) have recorded *E. excisus* from freshwater

fish in Turkey. There are many studies that were performed outside of Turkey that mention *E. excisus* in perch (Lee, 1977; Sattari *et al*., 2002; Shukerova *et al*., 2010).

Proteocephalus percae is a widespread and common parasite of perch. *Perca fluviatilis* is the definitive host for the tapeworm *Proteocephalus percae*. Planktonic crustaceans, and diaptomid or cyclopid copepods serve as the only intermediate hosts of all *Proteocephalus* species (Scholz, 1999). The prevalence and mean intensity of *Proteocephalus percae* were found to be higher in our study in the winter–spring period. Moravec (1979) found *Perca fluviatilis* to be infected by *Proteocephalus percae* in the Macha Lake in North Bohemia, Czechoslovakia from October to April. Poulin and Valtonen (2002) found that the abundance of *Proteocephalus percae* tended to be higher in winter, which is similar to our findings. Kadlec *et al*. (2002) also recorded the highest intensity of infection with *Proteocephalus percae* from *Perca fluviatilis* in spring.

A total of 376 specimens of *Glochidium* sp. was recorded, with the maximum prevalence (50%) found in autumn; however, a higher mean intensity was seen in summer (30.4 individuals).

Invasion of metacercariae of the eye fluke *Diplostomum* sp. was found to be very low, with a mean intensity of 6.2, in spite of a high prevalence of 71.1% when compared with *T. clavata*. Metacercariae of *Diplostomum* sp. are viable for several years and accumulate in fish eyes (Kennedy and Burrough, 1977). Infection of eyes restricts the vision of the fish, leading to a reduction in food supply and growth (Owen *et al*., 1993). According to Karvonen (2004), if infection intensity exceeds 20 metacercariae per fish harmful effects may be found. In the present study, only one fish had more than 20 metacercariae and the range of parasites in the other fish was 1–12 individuals.

C. complanatum is a digenetic trematod which causes yellow grubs in the muscle of fish. The first hosts are snails, the second are fish and the definitive hosts are piscivorous birds. If a human accidentally consumes raw or semi-cooked fish, the fluke attaches to the mucus membrane of the human oesophagus and causes a clinical syndrome called holzoun (Park *et al*., 2009). There are some reports of this syndrome from Japan and Korea (Isobe *et al*., 1994; Park *et al*., 2009). The first record of *C. complanatum* was made by Burgu *et al*. (1988) from *Alburnus* sp. and Öge and Sarımehmetoğlu (1996) from *Barbus plebejus* and *Capoeta tinca* in Turkey.

In conclusion, the results of the present study indicate that in perch from Lake Sığırcı, *T. clavata*, *E. excisus*, *Diplostomum* sp. and *Proteocephalus percae* are core parasite species, Glochidium sp. and *C. complanatum* are secondary species, *Gyrodactylus* sp. and *Tetracotyl* sp. are satellite species. High prevalence and mean intensity of *E. excisus* have negative impact on the marketability of perch. *C. complanatum* was found to be critically important as a zoonotic organism.

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