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Parasite Fauna of Fish in Büyükçekmece Dam Lake

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Abstract
Büyükçekmece Dam Lake, located in the Marmara Region, is the third largest water resource of the six main reservoirs of Istanbul. It is used as a safe drinking water source. In this study, the parasitic fauna of the freshwater fish species in Büyükçekmece Dam Lake was investigated during the period of September 2012-May 2013. Gill nets were used for the collection of fish specimens from the lake. The fish specimens were transported to the laboratory in fiberglass tanks and they were kept alive until parasitological examination. During the dissection, the body cavity, all internal organs, the gills, the eyes, the skin, and the fins were examined. A total of 273 fish specimens belonging to nine fish species were examined and 11 parasite species were found in infested individuals. *Ancylodiscoides vistulensis*, *Tetraonchus monenteron*, *Paradiplozoon homoion*, *Caryophyllaeus laticeps*, *Bothriocephalus acheilognathi*, *Raphidascaris acus* and *Eustrongylides excisus* were identified to the species level. *Trichodina* spp., *Dactylogyrus* spp., *Ergasilus* spp. and Glochidia larvae were identified the genus level in infested individuals. Monogenea was determined as the most common parasite group. *Eustrongylides excisus* was also observed as the most prevalent parasite in as different fish species.

Keywords: Büyükçekmece Dam Lake, *Eustrongylides excisus*, Monogenea, Parasitic fauna

Büyükçekmece Baraj Gölü Balıklarının Parazit Faunası

Öz
Marmara Bölgesi'nde bulunan Büyükçekmece Baraj Gölü, İstanbul'un altı ana rezervuarının üçüncü en büyük su kaynağıdır. Güvenli bir içme suyu kaynağı olarak kullanılır. Bu çalışmada Eylül 2012-Mayıs 2013 döneminde Büyükçekmece Baraj Gölü tatlı su balık türlerinin parazit faunası araştırılmıştır. Gölden balık numunelerinin toplanması için solungaç ağları kullanılmıştır. Balık örnekleri fiberglas tanklarda laboratuvara taşınmış ve parazitolojik inceleme yapılıncaya kadar canlı tutulmuştur. Diseksiyon sırasında vücut boşluğu, tüm iç organlar, solungaçlar, gözler, deri ve yüzgeçler incelenmiştir. Dokuz balık türüne ait olan toplam 273 balık örneği incelenmiş ve enfeste bireylerde 11 parazit türü bulunmuştur. *Ancylodiscoides vistulensis*, *Tetraonchus monenteron*, *Paradiplozoon homoion*, *Caryophyllaeus laticeps*, *Bothriocephalus acheilognathi*, *Raphidascaris acus* and *Eustrongylides excisus* tür seviyesinde teşhis edilmiştir. Enfeste bireylerde *Trichodina* spp., *Dactylogyrus* spp., *Ergasilus* spp. ve Glochidia larvası cins seviyesinde teşhis edilmiştir. Monogenea en yaygın parazit grup olarak tespit edilmiştir. *Eustrongylides excisus* ise farklı balık türlerinde en yaygın parazit olarak gözlenmiştir.

Anahtar Kelimeler: Büyükçekmece Baraj Gölü, *Eustrongylides excisus*, Monogenea, Parazit faunası

1. Introduction

Büyükçekmece Watershed, located in Çatalca district, west of Istanbul is a harbour in the Marmara Region, Turkey. It is used as a freshwater reservoir. The lake is the third largest water resource among the six main reservoirs in Istanbul, providing 17% of the water demand of the city, and used a safe drinking water resource. Various studies have been carried out on water pollution (Temel and Yardımcı, 2000; Guyer and İlhan, 2011), distributions of phytoplankton, zooplankton (Temel, 1996; Temel and Yardımcı, 2000, Güleçal and Temel, 2014) and the benthic organisms (Külköyoğlu et al., 1995; Altuğ and Koşal, 2007), fish fauna and

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their biology (Balık, 1985; Meriç, 1992; Özuluğ, 1999) in Büyükçekmece Dam Lake. In these studies the water quality of the lake was referred as second class according to the Turkish Water Pollution Control Regulation (TWPCR) and the trend shows tendency towards the third class. According to Guyer and İlhan (2011), agricultural areas impressed pollution of the lake.

It is generally accepted that the parasite fauna of an aquatic ecosystem is determined by the interaction of various biotic and a biotic factors. Fish parasites are adapted to the specific conditions of both their aquatic environment and their hosts (Pietrock et al., 2001). Parasites can be good indicators of environmental quality status and changes can be observed in parasite communities. However, according to our current knowledge, it is possible that this might not be relevant with specific causal factors or environmental changes. Fish parasites have also been used in some studies as indicators of pollution in aquatic habitats. Characteristic differences have been revealed in ectoparasite and endoparasite populations inhabiting lakes which harbour different trophic levels (Galli et al., 2001). Especially ectoparasite density increased proportionally with the eutrophication level while endoparasites were restricted to unpolluted lakes (Galli et al., 2001). Due to the obvious fact that fish parasites and parasites generally have a considerable effect on the ecosystem in the last couple of decades, we believe the parasitic fauna of the fish should be studied.

In Turkey, almost all identified protozoan fish parasites were external parasites, except for *Hexamita salmonis* (Öğüt and Akyol, 2005; Timur et al., 2009). The majority of these protozoan parasites in freshwater were ciliates (Kayış et al., 2009; Özer and Erdem, 1999; Özer et al., 2010, Öğüt and Altuntaş, 20011). So many metazoan fish parasites were also described in Turkey. The majority of metazoan parasites in freshwater fish consist of Monogenean. Monogeneans are among the most commonly reported parasitic agents of fish and their resistance to pollution stress that affects other gill parasites is high (Öztürk et al., 2000; Kayış et al., 2009; Akmirza and Yardımcı, 2014). In addition to these, digeneans, cestodes, nematodes, acanthocephalans, leeches and parasitic crustaceans have also been observed in Turkey. Although a large number of studies have been carried out on the parasitic fauna of freshwater fishes at Marmara Region (Öztürk and Altunel, 2001; Soylu, 2005; Karatoy and Soylu, 2006; Aydoğdu and Server 2006; Öztürk, 2011; Çolak, 2013; Akmirza and Yardımcı, 2014), there has been only one study so far, on the fish parasites in Büyükçekmece Dam Lake which mainly focused on only one species of fish and one species of parasite (Saç et al., 2015). For this reason, we can say that the results of the study do not represent the exact parasitic fauna of fish species in this reservoir. In this study, we determined the parasitic fauna of fish species in the lake. The purposes of this study are both determination of the parasite fauna of fish and contribute to biological diversity at the same time.

2. Material and Method

Büyükçekmece Dam Lake is a lagoon lake located in the mouth of Karasu Stream draining the Sea of Marmara (Figure 1). The sea connection of the lake was blocked by a dam constructed by ISKI in 1988. Büyükçekmece Dam Lake fed by streams and has approximately an area of 12 km^2 with shallow waters and the deepest point is about 5-6 m.

The fish specimens were collected from Büyükçekmece Dam Lake (41°,2',2.8824" N, 28°,35',24.0072" E) between September 2012 and May 2013 by gill nets and a total of 273 fish specimens were examined. Fish specimens were identified according to Geldiay and Balık (1999) and Özuluğ (1999). Four European catfish (*Silurus glanis*), eight pike (*Esox lucius*), fifty six European chubs (*Leuciscus cephalus*), seven rudd (*Scardinus*

erythrophthalmus), one hundred five roach (*Rutilus rutilus*), thirteen vimba (*Vimba vimba*), thirty two Prussian carp (*Carassius gibelio*), seventeen common carp (*Cyprinus carpio*) and thirty one perch (*Perca fluviatilis*) were transported into the laboratory in aerated tanks and they were kept alive until the parasitological examination.

During the dissection, the body cavity, all internal organs, the gills, the eyes (lens and vitreous humour), the skin, and the fins were checked. For the identification of parasites, we used light or dissecting microscopes and took photographs. Isolated parasites were examined alive or fixed and preserved according to Bylund et al., (1980). We followed the identification protocols used by Dawes (1968), Kabata (1979), Paperna et al., (1984), Moravec (1994), Kirjusina and Vismanis (2007) and Anderson et al., (2009). Mean intensity and prevalence values of some parasites were calculated according to Bush et al., (1997).

Figure 1. Study area.

3. Result and Discussion

Taxonomic studies on the fish in the basin Büyükçekmece Dam Lake are available (Meriç, 1992; Özuluğ, 1999). The Prussian carp was first reported by Özuluğ in 1999. Nowadays, it has become one of the most dominant fish species in the lake despite predators like pike, and also other cyprinids such as common carp, rudd (Saç and Okgerman, 2015). Although 23 fish species have been identified in the Büyükçekmece Dam Lake by Özuluğ (1999), nine fish species were caught by gill nets and examined for parasitic fauna during one year period in this study. We think that the main reason of decline of the population may be poaching and pollution in this area.

A total of 273 fish specimens were examined between September 2012 and May 2013. We found one protozoan, four monogenean, two cestode, two nematode, one arthropod and one mollusc species in infested fish. Parasitic species, host species, mean intensity and prevalence values for each parasite species are shown in Table 1. In some parasite species, the number of the individuals found on the fish sample was more than 50 and they could not be counted in their real value so they were stated as ">50" to avoid scientific faults.

Trichodina sp. (Ehrenberg, 1831)

Trichodina is a group of dorsoventrally flattened oval ciliated protozoan parasites that lives in freshwater, brackish water and sea water. Several Trichodina species were identified in different environments in Turkey (Özer and Erdem, 1998, 1999; Özer at al., 2010; Öğüt and Altuntaş, 2011). Although organic pollution gradient was becoming to increase *Trichodina* sp., *Trichodina* spp. was observed on the skin of two fish species in this study. We prepared slides using the squashing technique followed by silver nitrate staining; unfortunately details of the adhesive disk of these parasites could not be seen clearly.

Table 1. Parasitic species, fish host and their infestation rates in Büyükçekmece Dam Lake.

Parasite	Host	Site	Number of Fish	Prevalence %	Mean intensity
***Trichodina* spp.**	*Rutilus rutilus*	Skin	105	0,95	
	Cyprinus carpio	Skin	17	5,88	
Ancylodiscoides vistulensis	*Silurus glanis*	Gills	4	25	
Tetraonchus monenteron	*Esox lucius*	Gills	8	12.5	> 50
***Dactylogyrus* spp.**	*Rutilus rutilus*	Gills	105	3.81	
Paradiplozoon homoion	*Leuciscus cephalus*	Gills	56	3.57	4.5 (3-6)
Bothriocephalus acheilognathi	*Cyprinus carpio*	Intestinal tract	17	17.65	
Caryophyllaeus laticeps	*Leuciscus cephalus*	Intestinal tract	56	1.79	8
	Vimba vimba	Intestinal tract	13	38.46	5.4 (3-9)
	Rutilus rutilus	Intestinal tract	105	1.90	4.5 (2-7)
Eustrongylides excisus	*Silurus glanis*	Intestinal tract, intramuscular	4	100	19(3-37)
	Perca fluviatilis	Intestinal tract, intramuscular	31	74.19	∞ 20(1->50)
	Leuciscus cephalus	Intestinal tract, intramuscular	56	19.64	>15
	Rutilus rutilus	Intestinal tract, intramuscular	105	1.90	17
	Vimba vimba	Intestinal tract, intramuscular	13	15.85	7.5(6-9)
	Scardinus erythrophthalmus	Intestinal tract, intramuscular	7	14.29	19
Raphidascaris acus	*Esox lucius*	Intestinal tract	8	25	1.5 (1-2)
	Carassius gibelio	Intestinal tract	32	15.63	
***Ergasilus* spp.**	*Rutilus rutilus*	Gills	105	1.90	2 (1-3)
	Carassius gibelio	Gills	32	6.25	5.5 (3-8)
Glochidia larvae	*Rutilus rutilus*	Gills	105	2.86	4.33 (2-7)

Ancylodiscoides vistulensis (Sivak, 1932)

Ancylodiscoides vistulensis is a parasite specific to European catfish, distributed across Europe and Asia. It has a pair of anchors in haptor and connecting bar. The ventral anchors are smaller than dorsal anchors. The parasite was also observed from different lakes Terkos and Sapanca, such as Durusu on European catfish gills in same region (Soylu, 2005; Akmirza and Yardımcı, 2014). *A. vistulensis* was observed 60 % prevalence values on catfish gills in Durusu Reservoir by Soylu (2005) and 42,86% prevalence values in Sakarya River by Akmirza and Yardımcı (2014). But we were observed prevalence values in Büyükçekmece Dam Lake lower than Durusu Reservoir and Sakarya River.

Tetraonchus monenteron (Diesing, 1858)

Tetraonchus monenteron is a parasite specific to pike which is distributed across Europe, Asia and North USA. It attaches itself to the gills of the fish using two pairs of large hooks (Figure 2) and it has 16 marginal anchors in haptor. *T. monenteron* was the most prevalent species found in Lake Uluabat same as Işıklı Dam Lake for pike in Turkey (Öztürk et al., 2000; Öztürk and Özer, 2014). In this study, we were observed prevalence value 12,5 % on pike gills for *T. monenteron*.

Figure 2. *Tetraonchus monenteron* X100 (original).

Dactylogyrus sp. (Diesing, 1850)

Dactylogyrus have two pairs of anchors and use these anchors to attach onto the gills of freshwater fish. The monogeneans are oviparous. In seriously infected fish, Dactylogyrus can be also found on the buccal cavity. Dactylogyrus include 14 marginal hooks, four eye-spots, one to two connective bars, two needle-like structures and seminal vesicles which are spindle-shaped dactylogyrid-type. *Dactylogyrus* spp. has also been reported in many studies from Turkey (Soylu, 2005; Kayış et al., 2009; Öztürk, 2011) like our study. In this study, all of them vaginal tube and copulatory organ could not be seen clearly (Figure 3). One of them may be *Dactylogyrus difformoides*, but there could be more than one species.

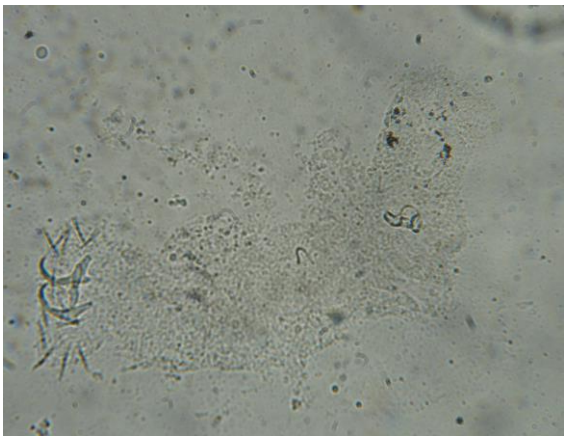

Figure 3. *Dactylogyrus* sp. X200 (original).

Paradiplozoon homoion (Bychowsky and Nagibina, 1959)

Paradiplozoon homoion, diplozoid monogenean parasites, is commonly found in the gills of freshwater fish. All diplozoids are ectoparasite with a direct life cycle. Their parasitic larvae are called as diporpa. Two larvae fuse in permanent cross copula and live as a pair in their adult life. The body consists of three different parts: genitalia, intestinal extension and haptors. Four pair of clamps is consisted in the attachment apparatus of adults. It also has a pair of central hooks situated on the haptors. P. homoion was observed cyprinid species from different studies in Turkey (Soylu, 2005; Karatoy and Soylu, 2006). In this study, we were observed prevalence value 3,57 % for *P. homoion* on European chubs gills (Figure 4).

Figure 4. *Paradiplozoon homoion* X100 (original).

Bothriocephalus acheilognathi (Yamaguti, 1934)

Bothriocephalus acheilognathi is principally parasitic to cyprinid fishes and has been reported from different geographical regions Asia, Australia, Europe, America and Africa (Nie et al., 2000; Dove and Fletcher, 2000; Borucinska, 2008; Kucha et al., 2012). It was reported that widely dispersed among the freshwater fish of Turkey (Aydoğdu et al., 2003; Tekin-Özan et al., 2008; Öztürk and Özer, 2014). In this study, we observed *B.*

acheilognathi was only observed in common carp (Figure 5). The parasite has two bothrium, two apical disks and an oval scolex. It has a number of segments in its structure.

Figure 5. Scolex structure of *Bothriocephalus acheilognathi* X100 (original).

Caryophyllaeus laticeps (Pallas, 1781)

Caryophyllaeus laticeps is a common parasite of cyprinid fishes in Europe. Life cycle of this species is indirect, requiring an intermediate host that contains a tubificid oligochaete. The adult parasite attaches itself to the intestinal wall of the fish host by a large scolex. It has an ovary resembling H-shaped. This parasite has been previously reported in cyprinid in Turkey (Cengizler et al., 2001, Akmirza and Yardımcı, 2014). It was observed in three different fish species, in this study (Figure 6).

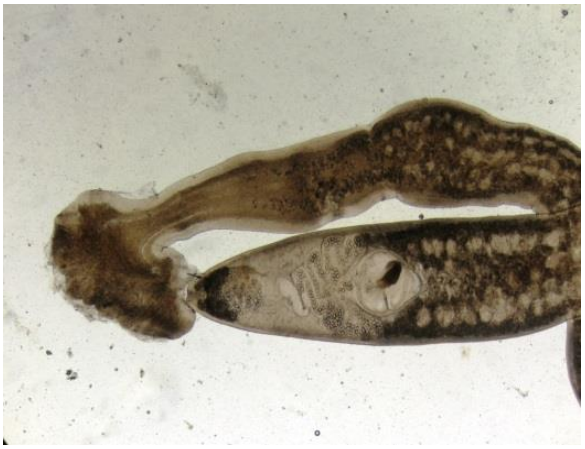

Figure 6. *Caryophyllaeus laticeps* X100 (original).

Raphidascaris acus (Bloch, 1779)

Raphidascaris acus is a widely distributed parasite found in the liver of fishes in Eurasia and North America (Gibson, 2001; Arai and Smith, 2016). *R. acus* uses herbivorous fishes as its intermediate host. It was previously reported only from pike (Aydoğdu and Server, 2006; Öztürk and Altunel, 2001) in Turkey but in this study it was observed on the intestinal tract and intramuscular of Prussian carp (Figure 7).

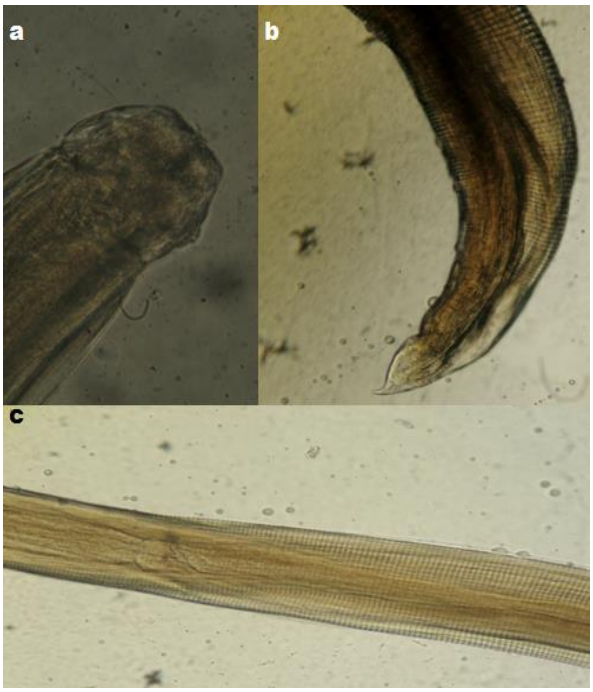

Figure 7. (a) Anterior region (b) posterior region X200 and (c) median region of *Raphidascaris acus* X100 (original).

Eustrongylides excisus (Jägerskiöld, 1909)

Eustrongylides excisus is a pollution tolerant nematode. The body of the larvae is surrounded by a thick brown capsule. Its length is about 25 mm. Third larval stage of the parasite has been identified in fish. These parasites were recovered several fish specimen in different lakes in Marmara Region, Turkey (Aydoğdu and Server, 2006; Kayış et al., 2009; Öztürk, 2011). *E. excisus* in which pollution tolerant was observed in 6 different fish species in this study (Figure 8).

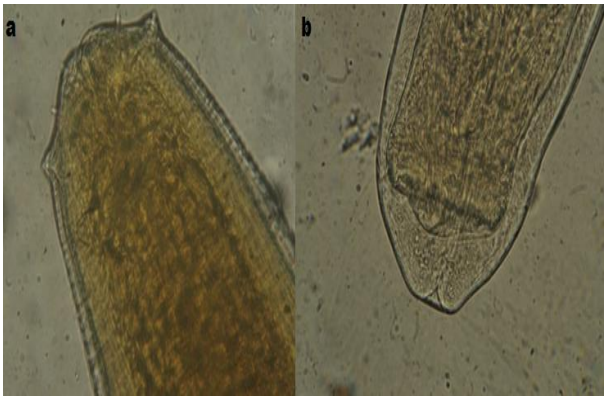

Figure 8. (a) Anterior and (b) posterior region of *Eustrongylides excisus* X200 (original).

Ergasilus spp.

Generally crustacean is an ectoparasite with a direct life cycle and they relatively have a high sensitivity to aquatic pollutions. *Ergasilus* sp. is parasitic crustaceans that prey upon freshwater and marine fishes. The fish are only its host for this reason it has a direct life cycle. It can be mating takes place while the male and female are swimming. After mating, the male dies. The egg clusters when egg incubation occurs are attached to the female. Cengizler and Göksu (1994) determined *Ergasilus sieboldi* on two Cyprinidae species living in the Balıklıağ Creek, Adana, Turkey. In this study, *Ergasilus* spp. were observed in two different fish species with a low prevalence value (Figure 9).

Figure 9. Female *Ergasilus* sp. X40 (original).

Glochidia larvae

Freshwater mussels are one of the most critically endangered groups of animals due to the habitat destruction, introduction of non-native species, and loss of host fishes, which their larvae (Glochidia) are obligate parasites. Parasitic Glochidia larvae, called T stages, were observed from three different fish species gills in this study (Figure 10). This obligatory parasite is attached to the gill filaments with bissus and damages epithelial tissue. Its shells have tooth rows. These were found larvae of Glochidia on the gills of several fish species (Çolak, 2013; Akmirza and Yardımcı, 2014).

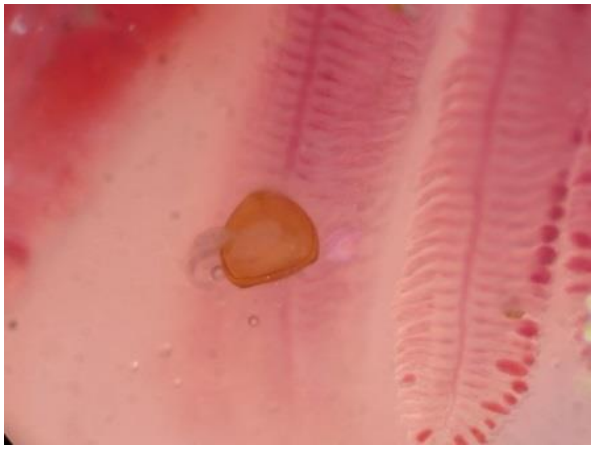

Figure 10. Glochidia larvae on the gill filaments of *Rutilus rutilus* X40 (original).

In conclusion, morphologically described eleven parasite species were recorded in the fish collected from Büyükçekmece Dam Lake. *Ligula intestinalis* infestation was observed during summer, autumn and winter from Büyükçekmece by Saç et al., (2015) in roach. However in this study, it was not observed not only in roach but also other fish species. Roach (*Rutilus rutilus*) was obtained high parasite composition compare to other fish species. Monogenea was determined as the most common parasitic group. *Eustrongylides excisus* was observed as the most prevalent parasite in different fish species. In the future, molecular studies will be necessarily done for identification of fish parasites. Büyükçekmece Watershed needs urgent and appropriate management strategy focusing on the urbanization, land use and effective protection.

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