

## Helminth Parasites of Common Carp (*Cyprinus carpio* L., 1758) in Beyşehir Lake and Population Dynamics Related to Month and Host Size

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### Abstract

Monthly variations and the effects of host size on parasite prevalence and mean intensity were examined in common carp (*Cyprinus carpio* L., 1758) from Beyşehir Lake in Turkey. This study was carried out between March 2003 and February 2005. A total of 233 fish were examined. Three parasite species were identified: *Dactylogyrus minutus*, *Caryophyllaeus laticeps*, *Bothriocephalus acheilognathi*. Infection with *Dactylogyrus minutus* was recorded on fish in all months with the exception of April. Peak infection occurred in May (69.23%). Infection of *C. Caryophyllaeus laticeps* was the highest in April (72.22%). Prevalence levels of *Bothriocephalus acheilognathi* were rather low, less than 35% in all months. The distribution of infrapopulations of *Dactylogyrus minutus*, *Caryophyllaeus laticeps* and *Bothriocephalus acheilognathi* did not vary significantly with size class of fish ( $P>0.05$ ), peaking in larger size classes.

**Key words:** Parasite, Monthly variations, Carp, Mean intensity, Turkey.

### Introduction

Common carp, *Cyprinus carpio* L., 1758, originated in Europe in rivers around the Black Sea and the Aegean basin, especially the Danube (Berra, 2001). Owing to its adaptation to a wide range of climatic and geographical conditions, many of parasites have been found in wild and domestic carp. The most complete checklist of carp parasites records a total of 310 parasite species (Baruš *et al.*, 2002).

The helminth fauna of common carp in Turkey was investigated by Oğuz (1991), Aydoğdu *et al.* (1997), Becer and Kara (1998), Özer and Erdem (1998; 1999) Aydoğdu *et al.* (2001), Özer (2002), Aydoğdu *et al.* (2003) and Kır *et al.* (2004). To date, the following parasites have been recorded from common carp in Turkey: *Dactylogyrus* sp. and *Dactylogyrus extensus* from some fresh water of the Bursa region (Kocadere, Ekinli and Uluabat) (Oğuz, 1991), *Argulus foliaceus*, *Neoechinorhynchus rutili* from İznik Lake (Aydoğdu *et al.*, 1997), *Caryophyllaeus laticeps*, *Ligula intestinalis* and *Argulus foliaceus* from Kovada Lake (Becer and Kara, 1998), *Dactylogyrus extensus*, *Ergasilus sieboldi* and *Caryophyllaeus laticeps* from Dalyan Lagoon (Aydoğdu *et al.*, 2001), *Dactylogyrus extensus*, *Caryophyllaeus laticeps* and *Bothriocephalus acheilognathi* from İznik Lake (Aydoğdu *et al.*, 2003) and *Argulus foliaceus*, *Dactylogyrus minutus*, *Caryophyllaeus laticeps*, *Ligula intestinalis* and *Bothriocephalus acheilognathi* from Karacaören Dam Lake (Kır *et al.*, 2004), *Trichodina acuta*, *Trichodina mutabilis*, *Trichodina nigra*, *Trichodinella subtilis*, *Apiosoma piscicola*, *Epistylis* sp., *Dactylogyrus anchoratus*, *Dactylogyrus*

*extensus*, *Gyrodactylus* sp., *Argulus foliaceus* from two localities in the Sinop Region (Özer and Erdem, 1999; Özer, 2002).

The first aim of this study was to determine the helminth parasite fauna of common carp in Beyşehir Lake. The other aim was to investigate the prevalence and mean intensity of parasite species on the host fish and in relation to fish size and monthly changes.

### Materials and Methods

#### Area Descriptions

Beyşehir Lake is located 75 km from the city of Konya (37°75' N, 31°30' E). The lake approximately 50 km long, 15-20 km wide and 10 m deep, covering an area of 1,125 km<sup>2</sup>. It is the largest freshwater lake in Turkey. It falls in class "A" and is an important visiting site for several bird species (Yarar and Magnin, 1997).

#### Sampling

This study was carried out between March 2003 and February 2005 (While giving the results, we amalgamated carp from the same month from different years). A total of 233 fish specimens were examined and number of fish samples is shown in Table 1. The carps were caught using net or hook by local fishermen. The specimens were placed in plastic tanks with local lake water and immediately transferred to the research laboratory where they were kept in aquarium and sacrificed within 24 hours. Fish were killed by vertebral dislocation and measured for total length to the nearest 0.5 cm. Lengths were

classified into six length classes (18.0-24.0 cm; 24.1-30.0 cm; 30.1-36.0 cm; 36.1-42.0 cm; 42.1-48.0 cm and >48.0 cm). During the dissection, the gill filaments, the eyes, the fins and the skin were examined. The gill filaments were placed in separate petri dishes with 1:4000 formaldehyde. The intestine was dissected and placed in separate petri dishes with physiological saline solution. Intestines and gills were thoroughly examined under a binocular microscope. All helminths found in each individual fish were identified and enumerated. The parasite specimens were fixed in formaldehyde, stained with aceto carmine and were mounted in Canada Balsam. During the study period, data on parasite species were categorized according to month. The environmental factors were not measured in this study.

The parasite specimens were identified using the reference keys of Bykhovskaya-Pavlovskaya *et al.* (1964), Reichenbach-Klinke (1966), Bauer (1987), Chubb *et al.* (1987) and Hoffman (1999).

### Statistical Procedures

Total numbers of parasites were determined directly by numerical count. The number of fish sampled, prevalence, mean intensity, standard deviations and maximum intensity values are given in tables. The prevalence and mean intensity levels were described earlier by Bush *et al.* (1997). One way ANOVA and Duncan's Multiple Comparison Test were used to compare the data among months and size classes at the level of 0.05. Statistical analysis of data was carried out using SPSS 12 package programs.

### Results

A total of 3 parasite species were found in 233 examined specimens of common carp from Beyşehir Lake. These were the monogenean gill parasite *Dactylogyrus minutus* (overall prevalence 37.76%) and two intestinal cestodes, *Caryophyllaeus laticeps* and *Bothriocephalus acheilognathi* (overall prevalence 30.9% and 7.29%, respectively). Data on the prevalence, mean intensity, standard deviation and maximum intensity of the three helminth species in the monthly samples of *Caryophyllaeus carpio* in Lake Beyşehir are given in Table 1.

During this study, infection with *Dactylogyrus minutus* was recorded on fish in all months with the exception of April. Mean intensity of *Dactylogyrus minutus* varied significantly among the months ( $P < 0.05$ ). The maximum mean intensity recorded in May (69.23 %) and minimum in June (17.64%). *Caryophyllaeus laticeps* was found to infect a large proportion of the fish samples throughout the year (range 4.00-72.22%). Significant differences were found in intensity levels of *C. laticeps* between months ( $P < 0.05$ ). The mean intensity was the highest in April (72.22%) and the lowest in October (4.00%). Prevalence (%) levels of *B. acheilognathi* were rather

low, less than 35% in all months. The infection was the highest in April (33.33%) and lowest in August (5.00%) (Table 1).

The infection parameters of helminths in the six size classes of fish studied are given in Table 2. The distribution of infrapopulations of *Dactylogyrus minutus* did not vary significantly with size class of fish ( $P > 0.05$ ). This parasite species was found on all size of host fish. The parasite attained maximum level on the largest fish specimens. *Caryophyllaeus laticeps* was found in all size of host fish, with a variance in the percentage of infection from 5.71 to 66.66. The differences of the distribution of infrapopulation of this species among the six size classes were significant ( $P < 0.05$ ). Parasite density was at maximum level in the largest fish specimens. *B. acheilognathi* was found in all size of the host fish at prevalence between 4.80 and 22.22%. The distribution of infrapopulations of *B. acheilognathi* among the six size classes was not significant ( $P > 0.05$ ), peaking in large size classes (V-VI).

### Discussion

In this study, the three parasite species identified on host fish and changes in their population patterns were determined in terms of fish size and months.

The study results showed that the most common parasite was *Dactylogyrus minutus*. This species has been known as a parasite of various freshwater fish, found most commonly in *Barbus capito pectoralis*, *Cyprinus carpio* and *Carassius carassius* in Turkey (Aydoğdu *et al.*, 2003; Kır *et al.*, 2004; Tekin-Özan and Kır, 2005). This parasite was recorded on the common carp throughout the year except for April. The infection was the highest in May and the lowest in June (Table 1). Aydoğdu and Altunel (2002) pointed out that intensity of infection by this species in common carp inhabiting İznik Lake increased from August to December and they (Aydoğdu and Altunel, 2002) explained this result with changes in water temperature. A lot of studies have been published on the seasonal changes of monogenean infection in fish (Shulman, 1989; Özer and Erdem, 1999; Özer, 2002). The data from the Lake Beyşehir seem to support the link with water temperature: In Beyşehir Lake, the highest infection of *Dactylogyrus minutus* in May corresponds with high water temperature. The seasonal variations of Dactylogyrids are influenced by temperature, oxygen concentrations of water, size of fish host and fish maturity (Zitnan, 1978; Pojmanska and Chabras, 1993)

In the present study, the infection of *Dactylogyrus minutus* was higher in small size classes (I-III) and in the largest size classes (VI), and lower in medium size classes (IV-V). Aydoğdu *et al.* (2003) studied the distribution of *D. extensus* in six classes of *C. carpio* from İznik Lake in Turkey and found positive relationships between the parasite intensity and host size. Nie and Kennedy (1991) reported

**Table 1.** Prevalence, mean intensity and maximum intensity of helminths in *Cyprinus carpio* from Beyşehir Lake and relationships between the parasite species and months

Month	March	April	May	June	July	August	September	October	November	December	January	February
N*	n=23	n=18	n=13	n=17	n=20	n=23	n=25	n=25	n=24	n=16	n=14	n=15
<i>D. minutus</i>												
Prevalence(%)	47.82 <sup>bc**</sup>	-	69.23 <sup>c</sup>	17.64 <sup>ab</sup>	25 <sup>bc</sup>	52.17 <sup>c</sup>	52.00 <sup>c</sup>	44.00 <sup>c</sup>	41.66 <sup>d</sup>	43.75 <sup>bc</sup>	50 <sup>bc</sup>	33.33 <sup>bc</sup>
Mean Inten.	11.25	-	21.60	12.66	13.40	21.66	20.41	18.45	36.20	16.71	14.57	16.00
(SD)	(4.47)	-	(12.78)	(8.96)	(8.98)	(10.70)	(10.49)	(7.72)	(18.89)	(4.11)	(5.09)	(5.95)
Max. Inten.	18	-	45	23	25	40	42	31	67	25	24	24
<i>C. laticeps</i>												
Prevalence(%)	39.13 <sup>ab</sup>	72.22 <sup>c</sup>	46.15 <sup>b</sup>	35.29 <sup>ab</sup>	20.00 <sup>ab</sup>	30.43 <sup>ab</sup>	8.00 <sup>ab</sup>	4.00 <sup>a</sup>	37.5 <sup>ab</sup>	18.75 <sup>ab</sup>	7.14 <sup>ab</sup>	40 <sup>ab</sup>
Mean Intensity	11.88	20.69	18.16	7.50	8.25	6.57	11.66	4.00	8.55	19.00	13.00	7.33
(SD)	(6.43)	(17.25)	(6.30)	(2.58)	(2.50)	(2.76)	(8.50)	(1.41)	(6.54)	(6.55)	(1.41)	(4.50)
Max. Intensity	23	106	28	12	11	11	20	5	21	85	17	14
<i>B. acheilognathi</i>												
Prevalence	13.04 <sup>ab</sup>	33.33 <sup>bc</sup>	-	-	5.00 <sup>a</sup>	-	24.00 <sup>c</sup>	-	-	6.25 <sup>ab</sup>	-	-
Mean Intensity	7.33	10.33	-	-	6.00	-	11.16	-	-	17.00	-	-
(SD)	(1.15)	(4.45)	-	-	(1.41)	-	(4.26)	-	-	(4.24)	-	-
Max. Intensity	8	46	-	-	5	-	17	-	-	14	-	-

(SD): Standard deviation

\*: Number of fish sampled

\*\*: Data shown with different letters are statistically significant at the P&lt;0.05 level.

**Table 2.** Prevalence, mean intensity and maximum intensity of helminths in the six size classes of fish studied

Size class	I	II	III	IV	V	VI
Length (cm)	18.0-24.0	24.1-30.0	30.1-36.0	36.1-42.0	42.1-48.0	>48.0
N*	n=21	n=54	n=104	n=35	n=10	n=9
<i>D. minutus</i>						
Prevalence(%)	42.85 <sup>a**</sup>	42.59 <sup>a</sup>	41.34 <sup>a</sup>	28.57 <sup>a</sup>	30.00 <sup>a</sup>	44.44 <sup>a</sup>
Mean Intensity	22.66	14.78	21.83	17.90	18.00	22.25
(SD)	(9.69)	(7.50)	(14.55)	(9.78)	(6.24)	(8.95)
Max. Intensity	40	29	67	35	25	32
<i>C. laticeps</i>						
Prevalence(%)	28.57 <sup>b</sup>	33.33 <sup>ab</sup>	43.26 <sup>a</sup>	5.71 <sup>ab</sup>	30.00 <sup>ab</sup>	66.66 <sup>ab</sup>
Mean Intensity	10.66	12.66	13.22	23.00	18.00	19.33
(SD)	(6.08)	(11.48)	(10.43)	(21.21)	(8.71)	(17.79)
Max. Intensity	20	106	57	38	28	54
<i>B. acheilognathi</i>						
Prevalence(%)	9.52 <sup>a</sup>	5.55 <sup>a</sup>	4.80 <sup>a</sup>	8.57 <sup>a</sup>	20.00 <sup>a</sup>	22.22 <sup>a</sup>
Mean Intensity	7.00	11.66	17.60	7.33	9.00	11.50
(SD)	(1.41)	(4.93)	(16.31)	(4.04)	(2.82)	(4.94)
Max. Intensity	8	15	46	12	11	15

(SD): Standard deviation

\*: Number of fish sampled

\*\*: Data shown with different letters are statistically significant at the P&lt;0.05 level.

higher infection levels in larger fish. According to Nie and Kennedy (1991), older fish provide more space for parasite attachment.

As indicated by Öktener (2003), *Caryophyllaeus laticeps* usually occurs in the intestine of *Cyprinus carpio*, *Rutilus rutilus*, *Blicca bjoerkna*, *Vimba vimba* and *Barbus plebejus escherichii* in Turkey. This parasite is known to infect over 40 species of fish and mainly cyprinids (Riggs and Esch, 1987). Aydoğdu and Altunel (2002) studied the distribution of *Caryophyllaeus laticeps* in common carp from İznik Lake in Turkey and pointed out that in İznik Lake, *Caryophyllaeus laticeps* was occurred mainly from November until June. Kulakovskaya (1964) showed that *Caryophyllaeus laticeps* larvae preserve their infectivity of fish all over the year. Proceroid life in their intermediate host is too long; because of this, they may result in their ability to infect fish all of the year (Aydoğdu and Altunel, 2002). The change in *Caryophyllaeus laticeps* may be related to the reproduction cycle of carp (Kennedy, 1968), physiological state of host, temperature of water and feeding activity of fish (Kennedy, 1969; Kennedy and Walker, 1969). In Beyşehir Lake, the peak of infection of *Caryophyllaeus laticeps* in April corresponds with the increasing feeding activity in common carp after winter starvation.

In this study, the infection of *Caryophyllaeus laticeps* was high in smaller size classes (I-III) and in the largest size class (VI). This phenomenon was reported earlier by Kulakovskaya (1962) and it was reported that it might be caused by young common carp feeding on tubicid which are intermediate hosts for *C. laticeps*.

*Bothriocephalus acheilognathi* commonly referred to as the Asian fish tapeworm has spread from Asia throughout Europe and parts of North America (Riggs and Esch, 1987). The infection of *Bothriocephalus acheilognathi* was the highest in April. Seasonal variations in the intensity of *B. acheilognathi* can be affected by temperature of water (Granath and Esch, 1983), metabolism, feeding activity of fish (Klenov, 1972). The data from Beyşehir Lake seem to support the significance of water temperature, with the peak of infection of *Bothriocephalus acheilognathi* in spring corresponding with the increased water temperature for completion of its life cycle (Braudner and Hoffranle, 1997).

*Bothriocephalus acheilognathi* was found in all fish sizes but high in the largest size classes (VI). This shows an increasing trend in the prevalence of the parasites according to length of fish host. This may be due to age of fish.

In this study, the helminth fauna on common carp in Beyşehir Lake was determined and also variance of infection rates were investigated in relation to months and size of host fish. It can thus be suggested that it is the species and feed activity of

host fish and the life cycle of parasites and the location of the lake play role in diversity. Also the choice and composition of the food is very important for the diversity of the helminth fauna in common carp.

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