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Metazoan Parasites of Bleak (*Alburnus alburnus*), Crucian Carp (*Carassius carassius*) and Golden Carp (*Carassius auratus*) in Enne Dam Lake, Turkey

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Abstract: Three species of fish, namely bleak (*Alburnus alburnus*), Crucian carp (*Carassius carassius*) and golden carp (*Carassius auratus*) were collected from Enne Dam Lake (Turkey) and examined for parasitic infections. The most common fish species was *A. alburnus* followed by *C. carassius* and *C. auratus*. Three species of Monogenea (*Dactylogyrus fraternus*, *Dactylogyrus alatus* and *Paradiplozoon homoion*) were recorded from the gills of *A. alburnus* whilst the monogeneans *Dactylogyrus anchoratus* and *Gyrodactylus katherineri* and the nematode *Contracaecum* sp. were found infecting *C. carassius* and *C. auratus*. There was a significant positive correlation between fish length, fish weight and infection rate in *Crucian carp*. However, no clear correlation existed between length, weight and parasite infections in bleak. In addition, a significant negative correlation was found between water temperature and *Contracaecum* sp. infections in golden carp.

Key words: Enne dam lake, *A. alburnus*, *C. carassius*, *C. auratus*, parasite, monogenea, *Dactylogyrus*, *Gyrodactylus*, *Paradiplozoon*, *Contracaecum*

INTRODUCTION

Helminth parasites of fishes represent an important component of freshwater ecosystems and in some cases are recognized as fish pathogens (Wyatt and Kennedy, 1989). Host mortality as a result of these infections is due to the complex interaction of many inter-related factors including parasite population dynamics and the presence of other disease agents. Poor environmental conditions may exacerbate the effect of disease leading to host mortality (Brown, 1989). In addition to direct mortality effects, sub lethal pathogenic effects are also recognized such as destruction of gill lamellae in *Diplozoon* infections of bream (Kagel and Taraschewski, 1993). There have been numerous surveys of helminth parasites of freshwater fish worldwide and there has been an increasing trend recently to incorporate ecological principles to the study of these important parasites (Kennedy, 1974; Chubb, 1977; Altunel, 1979; Molnar and Jalali, 1992; Gelnar *et al*., 1994). However, few studies have considered the relationship between biological parameters of the host and parasite success. (Dence, 1957; Kennedy, 1974).

Six fish species have been recorded in the Enne Dam Lake, namely *Alburnus alburnus* (bleak), *Carassius carassius* (Crucian carp), *Carassius auratus* (golden carp), *Barbus plebejus* (Italian barbel), *Leuscius cephalus* (chub) and *Nemacheilus* sp. (loach).

The current paper reports on the first study of the parasite fauna of three non-native fish species (bleak, Curician carp and goldfish), from the Enne Dam Lake in Turkey and provides data on the correlations between parasite infection rates and fish length and weight.

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MATERIALS AND METHODS

Enne Dam Lake is 15 km northwest of Kutahya and is fed by a geothermal water source called Yoncali and two other smaller streams. Fish were caught at six stations in the Enne Dam Lake at monthly intervals in two years between January and February, using seine and dip nets and transported live back to the laboratory in water from the locality. Fish species were identified according to Geldiay and Balik (1988).

Fish were killed by a sharp blow to the head, followed by exsanguinations and total fish length (to the nearest mm) and total weight (to nearest gram) for each individual fish were recorded. Gills were removed and examined for the presence of monogeneans. Parasites were either removed from the gills to allow speciation or fixed in neutral buffered formalin, whilst still attached to the gill filaments. Some of them were fixed in glacial acetic acid and stored in 70% ethanol and then stained with Mayer's haematoxylin. The intestine tract (from oesophagus to vent) was removed and transverse sections were taken. The sections were examined for the presence of endoparasites with a stereomicroscope. Parasite numbers were enumerated and stored in 70% ethanol for further examination. Parasites were identified according to the keys of Bychovskaya-Pavlovskaya (1962) and Bauer (1965). The measure of level of infection used was prevalence, defined as the number of fish infected by a particular parasite species divided by the total number of fish in the sample, expressed as a percentage.

Correlation test was applied on the values of % parasite prevalence, fish length, fish weight and water temperature to define the relation between % parasite prevalence and other parameters namely fish length, fish weight and water temperature for each parasite species (Little and Hills, 1978).

RESULTS

Six fish species were caught during the survey namely *A. alburnus*, *C. carassius*, *C. auratus*, *Barbus plebejus escherichi*, *Leuscius cephalus* and *Nemacheilus* sp. The most abundant species was *Alburnus alburnus* in the lake followed by *C. carassius* and *C. auratus*, while other species were rarely caught in the lake.

A total of 341 *A. alburnus*, 117 *C. carassius* and 81 *C. auratus* were examined for their parasites in this study. *A. alburnus* were infected with the monogeneans *Dactylogyrus fraternus, D. alatus* and *Paradiplozoon homoion* and *C. carassius* and *C. auratus* were parasitised by *D. anchoratus* (Monogenea), *Gyrodactylus katherineri* (Monogenea) and *Contracaecum* sp. (Nematoda) (Table 1). In addition, *Allocreadium isoporum* (Digenea) and *Pomphorhynchus laevis* (Acanthocephala) were found in bleak, c. carp, goldfish and loach in low numbers. These data are not included in the analysis. Overall, 36.3% of the bleak were infected with at least one parasite species, with 22.6% of the *Carassius* sp. infected with at least one parasite. The most prevalent parasite was *D. fraternus* which was found in 50% of the bleak throughout the sampling period. It was found, however, at prevalence of up to 70% during month/year. *G. katherineri* was the most prevalent parasite in *C. auratus* and *C. carassius* at prevalence of 38 and 37%, respectively. *Contracaecum* sp. was found at the lowest prevalence overall at 2 and 6% in *C. carassius* and *C. auratutus*, respectively. However, in one sample, *Contracaecum* sp. was found at a prevalence of 50% during month/year in *C. carassius*.

There were several significant positive correlations between fish length, fish weight and parasite prevalence in *Carassius* sp. (Table 2). In particular, in *C. carassius* there was a positive correlation between length and *D. anchoratus* prevalence ($p<0.05$), between length and *Contracaecum* sp. prevalence ($p<0.01$) and between weight and *D. anchoratus* prevalence ($p<0.05$), between weight and *G. katherineri* prevalence ($p<0.01$) and between weight and *Contracaecum* sp. prevalence ($p<0.01$). In addition, in *C. auratus* there was positive correlation between length and *D. anchoratus* prevalence ($p<0.05$), between length and *Contracaecum* sp. prevalence ($p<0.05$), between weight and

Table 1: Infection rate of the fishes, according to fish weight and length. Values in the table are mean of the measurements of two years

Alburnus alburnus			Infection rate (%)		
No. of fish examined	Mean total weight (g)	Mean total length (mm)	*Dactylogyrus fraternus*	*Dactylogyrus alatus*	*Paradiplo hommonion*
4	4.0	69	50	50	100
24	4.5	74	66	42	42
18	6.5	78	61	28	33
28	9.2	85	50	17	21
30	9.8	89	36	13	23
27	10.5	92	63	39	29
27	11.7	95	66	48	37
23	13.3	98	69	52	26
23	14.4	101	57	38	21
19	15.8	104	32	16	16
28	16.3	107	32	21	25
23	18.8	111	60	48	17
27	20.1	114	30	22	11
23	22.5	117	28	20	24
10	23.8	120	70	60	60
3	25.5	122	67	-	100
4	37.5	138	-	25	25
*341			50	37	30
			36.3		

Carassius carassius			Infection rate (%)		
No. of fish examined	Mean total weight (g)	Mean total length (mm)	*Dactylogyrus anchoratus*	*Gyrodactylus katherineri*	*Contracaecum* sp.
13	27.5	95	30	38	-
15	39.8	105	30	40	-
18	49.0	130	22	27	5
23	60.3	140	13	39	-
22	81.0	145	22	27	4
12	101.7	150	25	42	-
5	120.3	162	40	40	-
2	153.2	168	50	100	-
3	161.3	182	66	67	-
2	168.5	190	50	100	-
2	190.1	218	-	50	50
*117			31	37	2
			22.67		

Carassius auratus			Infection rate (%)		
No. of fish examined	Mean total weight (g)	Mean total length (mm)	*Dactylogyrus anchoratus*	*Gyrodactylus katherineri*	*Contracaecum* sp.
7	28.5	102	-	-	-
10	37.8	116	14	-	-
12	47.9	126	30	30	10
19	54.5	138	25	50	-
6	70.2	144	16	47	5
10	92.1	153	67	50	16
4	139.3	162	40	40	10
3	153.1	168	50	50	-
4	162.5	171	67	67	-
3	166.3	175	50	25	25
3	170.2	188	-	33	-
*81			30	38	6
			22.68		

*Total number of examined fish, (-) No infection

D. anchoratus prevalence ($p<0.05$), between weight and *Contracaecum* sp. prevalence ($p<0.05$) andnegative correlations between water temperature and *Contracaecum* sp. prevalence ($p<0.05$). No significant correlations were shown with parasite prevalence and length, weight and water temperature in bleak samples.

There was no significant correlation between water temperature and prevalence except infections of *C. auratus* by *Contracaecum* sp. (Table 2 and 3). For example, the prevalence of *D. fraternus* in *A. alburnus* is 77% in March when the water temperature was 5.5 and 76% in June when the water temperature was 17°C. Thus, almost no differences between winter and summer water temperatures were found in respect to infection rate of the fishes (Fig. 1).

Table 2: Correlations of percent fish infection with fish weight, fish length and water temperature in *A. alburnus*, *C. carassius* and *C. auratus* species with respect to several parasite species

Alburnus alburnus

Parasites	Prevalence versue length (%)	Prevalence versus weight (%)	Prevalence versus water temperature (%)
D. fraternus	-0.439	-0.503	-0.287
D. alatus	-0.236	-0.242	-0.092
P. hommoion	-0.059	-0.138	0.392

Carassius carassius

Parasites	Prevalence versue length (%)	Prevalence versus weight (%)	Prevalence versus water temperature (%)
D. anchoratus	0.652*	0.806**	0.161
G. katherineri	0.532	0.706*	0.299
Contracaecum sp.	0.984**	0.967**	-0.399

Carassius auratus

Parasites	Prevalence versue length (%)	Prevalence versus weight (%)	Prevalence versus water temperature (%)
D. anchoratus	0.756*	0.732*	-0.033
G. katherineri	0.026	0.008	-0.197
Contracaecum sp.	0.689*	0.698*	-0.593*

**Correlation coefficient, significant at 0.01 levels, * Correlation coefficient, significant at 0.05 levels

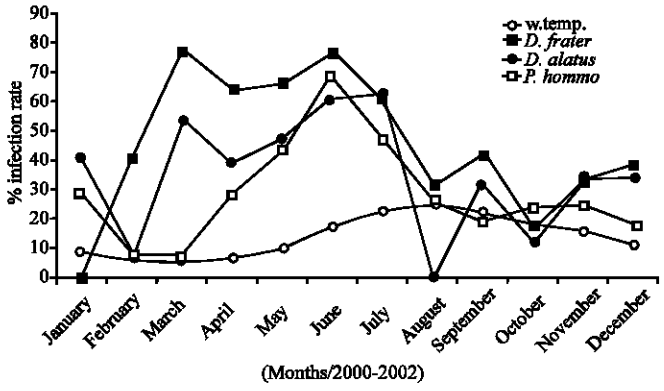

Fig. 1: Infection rates of *A. alburnus* by the parasites depending on water temperatures. Values are mean of two years

Table 3: Infection rate of fishes, according to water temperature in a year. Values in the table are mean of the measurements of two years

		A. alburnus rate of infection (%)		
Months	Water temp. mean (°C)	*D. fraternus*	*D. Alatus*	*P. hommoion*
January	8.5	-	41.0	28.5
February	6.0	40.5	8.0	8.0
March	5.5	77.0	53.5	7.5
April	6.5	63.5	39.0	28.0
May	10.0	65.5	46.5	43.5
June	17.0	76.0	61.0	69.0
July	22.5	61.0	62.0	47.5
August	24.5	31.0	27.0	26.5
September	21.5	41.5	31.5	18.5
October	17.5	17.5	11.5	24.0
Novermber	15.5	32.5	33.5	24.5
December	11.0	37.5	34.0	18.5

		C. carassius rate of infection (%)		
Months	Water temp. mean (°C)	*D. anchoratus*	*G. katherineri*	*Contracaecyn* sp.
Januray	8.5	-	-	-
February	6.0	-	-	-
March	5.5	40.0	50.0	-
April	6.5	35.5	53.5	11.0
May	10.0	52.5	52.5	6.5
June	17.0	39.0	60.0	-
July	22.5	58.0	54.0	-
August	24.5	32.5	77.5	-
September	21.5	12.5	25.0	-
October				
Novermber				
December				

		C. auratus rate of infection (%)		
Month	Water temp. mean (°C)	*D. anchoratus*	*G. katherineri*	*Contracaecum* sp.
January	8.5	-	-	-
February	6.0	-	-	-
March	5.5	30.0	50.0	20.0
April	6.5	49.5	66.5	16.5
May	10.0	65.0	87.5	10.0
June	17.0	66.5	49.5	-
July	22.5	-	66.5	-
August	24.5	-	-	-
September	21.5	-	-	-
October				
Novermber				
December				

(-) No infection

DISCUSSION

All the monogeneans found during the current study are considered new locality records, with the exception of *P. hommoion*, which was recorded in Turkey by Ozturk (2000). The most abundant fish caught in the dam lake was *A. alburnus* and its infection rate is higher than the other fishes as well. On the other hand, *A. alburnus* was exposed to infection all over the year, whereas *Carassius* species were infected mainly between March and September. Similar results in different fish species were also found in Manyas Lake (Turkey) by Ozturk (2000) and by Aydogdu and Altunel in Iznik Lake (2002).

The parasites causing higher infection are *D. fraternus* in *A. alburnus* fish and *G. kataharineri* in *Carassius* fishes. An interesting result from this study is that parasites are Genus specific not species specific; that is, while parasites of *A. alburnus* are different from of *Carassius*, parasites of *C. carassius* and *C. auratus* are the same. In several studies, it has been shown that *D. alatus* and *D. fraternus* parasites are specific for *Alburnus* Genus (Lambert, 1977; Dupont and Lambert, 1986; Gelnar *et al*., 1994). In addition, all *Diplozoon* parasites of *A. brama* in Norway were found to be only *Diplozoon paradoxum* (Halvorsen, 1969). However, *Dactylogyrus* parasites are not Genus specific. Thus, this parasite has been detected in carp fish (*Cyprinus carpio*) (Oguz, 1991) and also in *Carassius* in this study.

In general, there was no significant correlation between water temperature of the dam lake and fish infection, except infection of *C. auratus* by *Contracaecum* sp., which shows negative correlation at 0.05 level of significance. There also were negative correlations concerning other fishes in this respect, but statistically not significant. In general, there seems to be a negative correlation between water temperature and fish infection at least for the fish species and parasites studied; that is, increases in water temperature correspond to decreases in fish infection. These fish species may be exposed to cold stress in lower water temperature and this may facilitate fish infection.

Contrarily, Zitnan and Hanzelova (1984) have indicated that the infection rate of carp fishes by *Bothriocephalus acheilognathi* (*gowkongensis*) increases with increasing water temperature andreaches its maximum in July and August. Similarly, the infection rate of carp fishes by *Dactylogyrus extensus* increases with increasing water temperature and reaches to maximum at June in Hungary (Molnar and Szekely, 1995). This situation may vary depending on fish species and water properties.

There was a significant positive correlation between fish length, fish weight and infection rate of *Carassius*, for the parasites studied. However, there was no significant correlation in *A. alburnus* in this respect. Thus, we can say that the relation between fish length, fish weight and fish infection is Genus specific; therefore the results can not be generalized for all fish species.

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