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Annual Dynamics of Tapeworm, *Ligula intestinalis* Parasitism in Tench (*Tinca tinca*) from Beysehir Lake, Turkey

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Abstract: In this study, tench (*Tinca tinca*) were caught between March 2003 and February 2004 in Lake Beysehir and examined for *Ligula intestinalis* plerocercoid infestation. Prevalence ranging from 25.80±2.29-96.88±2.17, increased with increasing fish size. Index of parasitization (I_p) differed among the length classes. Monthly fluctations in I_p values were also significant ($p<0.05$). Minimum I_p was determined as 1.50±0.26 in April and maximum I_p 4.64±0.60 in January. Mean intensity varied in the length classes. During the studied period, significant differences were observed between mean intensity of plerocercoids values and the months ($p<0.05$).

Key words: *Ligula intestinalis*, prevalence, mean intensity, parasitic-index, tench *Tinca tinca*, Beysehir lake, Turkey

INTRODUCTION

Tench (*Tinca tinca* L., 1758), typical member of the cyprinidae family has economic importance and shows a wide range of distribution in the freshwater of Turkey (Geldiay and Balik, 2007). In addition, it has an important role in the mineralization of the water since it constantly stirs the mud at the bottom (Alas and Ak, 2007). Although, its consumption is less at local area, filleted catches are exported to the USA and Europe.

Ligula intestinalis (L.) is a significant fish parasite because heavy infestations induce host mortality, which is a threat to the commercial fisheries industry (Brown *et al*., 2002; Innal *et al*., 2007). It also causes pathological conditions such as the distension of the host's body wall, muscle and gonadal atrophy, lowered condition factors and a number of physiological and immunological disorders. Adult gravid ligulids in the final bird hosts disseminate their eggs over large areas through the hosts droppings, making it difficult to control infection in wild fish populations. There is concern over human health risks associated with the eating of infected fish, especially when raw or not properly cooked (Barson and Marshall, 2003).

Ligula intestinalis (L.) has been the subject of a number of studies, mainly those aimed at differences in pathogenicity and parasite-host relationships (Arme and Owen, 1968; Sweeting, 1977; Kennedy and Burrough, 1981; Barus and Prokes, 1994, 2002; Brown *et al*., 2002; Kennedy *et al*., 2001; Oktener, 2003; Ergonul and Altindag, 2005; Koyun, 2006; Hajirostamloo, 2008). In Turkey, there is two study dealing with the parasite-host relation of *Ligula intestinalis* (L.) *Tinca tinca* (Yavuzcan *et al*., 2003; Ergonul and Altindag, 2005).

The aim of the present study was to analyse the annual dynamics of the actual prevalence, mean intensity and parasitic index of infection with *Ligula intestinalis* (L.) in tench from Beysehir lake.

MATERIALS AND METHODS

A total of 487 tench (*T. tinca*) were caught with gillnets from Beysehir lake, which is one of the largest lakes with 690 km^2 surface area in Turkey. Fishes were sampled between March 2003 and February 2004. Fish samples were transported to the laboratory where their fork lenghts (cm) and weights (g) were measured. The body cavity of each fish was examined for presence of *Ligula intestinalis* (L.) plerocercoids if present, the number plerocercoids was counted and total weight was recorded nearest to 0.1 g. A feature of infections with ligulid plerocercoids is the large relative weight of parasite to host tissue. This is expressed in the parasitic index as stated by Arme and Owen (1968). Parasitic index (I_p) was used in assessing the intensity of infection for each fish:

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$$I_p = 100\ W_p \times W^{-1}$$

where:

W_p = The parasite mass

W = The host mass

Prevalence (%) and mean intensity values of plerocercoids were determined according to Bush *et al.* (1997).

In the presentation of data on infections the fish were classified into groups according to their length. One-way Analysis of Variance (ANOVA) was used to test the differences in the mean intensity, parasitic index and prevalence. Duncan multiple test was used to compare the differences among mean values. Differences were regarded as significant when $p<0.05$.

RESULTS AND DISCUSSION

The prevalence values of *Ligula intestinalis* (L.) plerocercoids in *T. tinca* were shown in Table 1. The prevalence of the plerocercoids in tench were compared within each length class and for the months studied. Differences among the mean prevalence values, the months and length classes were statistically significant ($p<0.05$). There was a strong relationship between the mean prevalence values and length classes ($R^2 = 0.6919$).

The mean prevalence values of infection by plerocercoids of *L. intestinalis* in tench were changed from 25.80-96.88% (Table 1). The mean prevalence values were the maximum in October and the minimum in July. The period of the maximum prevalence values found in this study is not complying with the previous studies. Banu *et al.* (1993), Akhter *et al.* (1997) and Bhuiyan *et al.* (2007) also reported more incidence of diseases in fish during winter months. Ozan *et al.* (2006) reported that infection of *L. intestinalis* in tench was decreased in summer while it was increased in winter. Yavuzcan *et al.* (2003) were determined that prevalence of *L. intestinalis* in tench from Beysehir lake over a period of 5 months was the highest in February. The pattern observed in this study may be attributed to the feeding behaviour of tench and the seasonal dynamics of appopriate copepod hosts. Accordingly, the maximum or minimum values of prevalence are possibly not related with the season.

In this study, the mean parasitic Index (I_p) values were given in Table 2. The mean I_p values according to months and length classes were varied between 1.50 (April) and 4.64 (January), 1.01 (36.5-40.4 cm) and 5.81 (12.5-16.4 cm), respectively ($p<0.05$). We record that the mean I_P values were inversibly correlated to length classes ($R^2 = 0.9208$). In this study, we found that plerocercoids weighed up to 12,85% of the tench weight. Arme and Owen (1968) found that plerocercoids weighed up to 50% of the roach weight. Barus and Prokes (1994) reported that I_P percent values fluctuated between 0.4 and 17.7% in *Blicca bjoerkna* and they also observed that I_P percent value did not exceed 20% in *Rutilus rutilus*, *Blicca bjoerkna* and *Abramis brama* (Barus and Prokes, 2002). Yavuzcan *et al.* (2003) found that I_P values fluctuated between 2.72 and 5.55% in tench in Beysehir Lake. Ergonul and Altindag (2005) declared that I_P percent values fluctuated between 0.1 and 7.60% in tench in Mogan lake. This findings were similar to the reports of Yavuzcan *et al.* (2003) and Ergonul and Altindag (2005).

In this study mean intensity values were ranged 1-14 plerocercoids per infected fish in the whole sample (Table 3). Mean intensity values according to months were significantly differed ($p<0.05$). Mean intensity values were highly correlated with increasing fish size except length class of 36.5-40.4 cm ($R^2 = 0.8732$). Mean intensity in the particular months sampled did not exhibit a marked pattern. The mean intensity values of *L. intestinalis* measured in *T. tinca* in the present study was relatively

Table 1: Prevalence (%) values of *Ligula intestinalis* plerocercoids in different length classes of tench

	Length classes (cm)							
Months	12.5-16.4	16.5-20.4	20.5-24.4	24.5-28.4	28.5-32.4	32.5-36.4	36.5-40.4	Mean±SE
March	-	40.00	37.50	37.50	57.14	50.00	100.00	$47.37\pm2.06^{*e}$
April	-	37.50	33.33	54.55	57.14	100.00	100.00	$54.55\pm3.37^{c,d}$
May	-	20.00	25.00	90.91	60.00	66.67	0.00	52.94 ± 5.46^{d}
June	-	55.56	50.00	80.00	57.14	50.00	100.00	64.52 ± 2.45^{b}
July	0.00	20.00	23.08	16.67	25.00	50.00	100.00	25.80 ± 2.29^{g}
August	-	27.17	27.78	10.00	12.50	100.00	100.00	30.00 ± 3.33^{g}
September	-	100.00	64.29	63.64	100.00	100.00	-	68.97 ± 2.35^{b}
October	-	100.00	100.00	100.00	100.00	50.00	100.00	96.88 ± 2.17^{a}
November	100.00	58.82	54.17	55.56	50.00	66.67	-	$56.90\pm0.88^{c,d}$
December	-	21.05	28.57	66.67	100.00	100.00	-	37.21 ± 3.87^{f}
January	50.00	61.11	55.56	25.00	66.67	100.00	100.00	59.09 ± 2.54^{c}
February	-	40.00	36.36	61.54	20.00	66.67	100.00	46.51 ± 2.59^{e}
Mean±SE	$*50.00\pm9.45^{d}$	41.32 ± 1.80^{f}	45.64 ± 1.92^{e}	60.20 ± 2.38^{c}	49.99 ± 3.00^{d}	73.07 ± 4.14^{b}	91.67 ± 8.33^{a}	-

*Values with different superscripts in a column and row indicate significant differences ($p<0.05$)

Table 2: Monthly parasitization index (I_p) values of *Ligula intestinalis* plerocercoids in different length classes of tench

	Length classes (cm)							
Months	12.5-16.4	16.5-20.4	20.5-24.4	24.5-28.4	28.5-32.4	32.5-36.4	36.5-40.4	Mean±SE
March	-	2.60 ± 0.45^{e}	4.77 ± 0.55^{c}	2.21 ± 0.74^{d}	1.25 ± 0.33^{f}	$0.87^{c,d}$	$0.74^{a,b}$	$2.10\pm0.37^{*h}$
April	-	1.16 ± 0.29^{h}	5.59^{a}	1.21 ± 0.17^{f}	1.31 ± 0.27^{f}	$1.37\pm0.41^{b,c,d}$	$1.38^{a,b}$	1.50 ± 0.26^{j}
May	-	2.41 ± 1.56^{f}	2.21^{f}	3.38 ± 0.96^{b}	4.39 ± 1.10^{a}	$1.54\pm0.56^{b,c}$	-	3.17 ± 0.59^{c}
June	-	6.26 ± 1.40^{b}	1.27^{h}	2.18 ± 0.44^{d}	0.99 ± 0.40^{g}	$0.99^{c,d}$	1.72^{a}	2.83 ± 0.60^{e}
July	-	6.18 ± 1.64^{b}	2.04 ± 0.48^{g}	0.86 ± 0.45^{h}	2.60 ± 2.02^{c}	$1.08^{c,d}$	$0.70\pm0.15^{a,b}$	2.17 ± 0.52^{h}
August	-	2.95 ± 0.88^{d}	2.18 ± 0.71^{f}	2.08^{d}	1.98^{e}	0.69^{d}	$0.80^{a,b}$	2.11 ± 0.40^{h}
September	-	1.10^{h}	2.78 ± 0.57^{e}	1.77 ± 0.39^{e}	2.26 ± 0.27^{d}	2.09^{b}	-	2.26 ± 0.31^{g}
October	-	3.04 ± 0.79^{d}	5.24 ± 0.84^{b}	3.71 ± 1.14^{a}	3.12 ± 1.08^{b}	3.46^{a}	1.65^{a}	4.30 ± 0.54^{b}
November	6.88^{a}	2.96 ± 0.71^{d}	1.97 ± 0.36^{g}	2.67 ± 0.69^{c}	0.75 ± 0.40^{h}	$1.27\pm0.60^{c,d}$	-	2.41 ± 0.32^{f}
December	-	5.80 ± 2.29^{c}	2.27 ± 0.61^{f}	1.18 ± 0.47^{f}	4.40 ± 2.00^{a}	$1.45\pm0.34^{b,c}$	-	3.04 ± 0.75^{d}
January	5.45 ± 1.46^{b}	6.71 ± 0.83^{a}	4.07 ± 0.97^{d}	$0.97^{g,h}$	$2.19\pm0.97^{d,e}$	$1.22\pm0.55^{c,d}$	$1.14\pm0.57^{a,b}$	4.64 ± 0.60^{a}
Februbary	-	2.11 ± 0.47^{g}	2.76 ± 0.94^{e}	$1.08\pm0.22^{f,g}$	$2.19\pm1.24^{d,e}$	3.30 ± 0.63^{a}	0.42^{b}	1.92 ± 0.31^{i}
Mean±SE	$5.81\pm1.09^{*a}$	4.12 ± 0.41^{b}	3.26 ± 0.29^{c}	2.22 ± 0.25^{d}	2.08 ± 0.28^{e}	1.62 ± 0.22^{f}	1.01 ± 0.15^{g}	-

*Values with different superscripts in a column and a row indicate significant differences ($p<0.05$)

Table 3: Mean intensity values of *Ligula intestinalis* plerocercoids in different length classes of tench

	Length classes (cm)							
Months	12.5-16.4	16.5-20.4	20.5-24.4	24.5-28.4	28.5-32.4	32.5-36.4	36.5-40.4	Mean±SE
March	-	$1.50\pm0.50^{e,f}$	3.33 ± 0.33^{c}	2.67 ± 0.88^{e}	2.00 ± 0.50^{j}	$3.00^{d,e}$	1.00^{d}	$2.16\pm0.31^{*d}$
April	-	1.00 ± 0.00^{h}	5.00^{a}	1.17 ± 0.17^{h}	2.25 ± 0.75^{i}	$2.33\pm0.33^{e,f}$	$3.00^{b,c}$	1.79 ± 0.29^{d}
May	-	1.00 ± 0.00^{h}	4.00^{b}	4.60 ± 1.45^{a}	10.67 ± 2.03^{a}	$3.00\pm1.00^{d,e}$	-	4.50 ± 1.02^{a}
June	-	3.20 ± 0.49^{b}	2.00^{f}	2.63 ± 0.63^{e}	1.50 ± 0.29^{k}	1.00^{g}	$4.00^{a,b}$	$2.38\pm0.33^{c,d}$
July	-	3.50 ± 0.50^{a}	$1.50\pm0.34^{h,i}$	1.50 ± 0.50^{g}	3.00 ± 2.00^{h}	2.00^{f}	1.67 ± 0.33^{d}	1.88 ± 0.31^{d}
August	-	1.33 ± 0.33^{g}	1.60 ± 0.40^{h}	3.00^{d}	5.00^{c}	$3.00^{d,e}$	1.00^{d}	1.85 ± 0.37^{d}
September	-	1.00^{h}	1.89 ± 0.35^{g}	1.86 ± 0.26^{f}	4.00 ± 1.00^{e}	4.00^{c}	-	1.96 ± 0.28^{d}
October	-	2.33 ± 0.67^{d}	3.38 ± 0.52^{c}	3.57 ± 1.02^{b}	4.67 ± 1.76^{d}	5.00^{b}	$2.00^{c,d}$	3.34 ± 0.39^{b}
November	4.00^{a}	1.60 ± 0.34^{e}	1.46 ± 0.18^{i}	3.40 ± 0.51^{c}	3.00^{h}	3.33 ± 0.88^{d}	-	2.03 ± 0.22^{d}
December	-	2.75 ± 0.75^{c}	1.25 ± 0.25^{j}	1.50 ± 0.29^{g}	5.50 ± 1.50^{b}	$2.50\pm1.50^{e,f}$	-	2.11 ± 0.43^{d}
January	2.00 ± 1.00^{b}	3.36 ± 0.58^{a}	3.00 ± 0.63^{d}	1.00^{I}	3.50 ± 1.50^{f}	$2.50\pm0.50^{e,f}$	4.50 ± 1.50^{a}	$3.08\pm0.34^{b,c}$
Februbary	-	$1.40\pm0.25^{f,g}$	2.40 ± 0.75^{e}	1.43 ± 0.20^{g}	3.25 ± 1.65^{g}	10.00 ± 4.00^{a}	-	$2.52\pm0.60^{c,d}$
Mean±SE	$0.71\pm0.38^{*g}$	2.24 ± 0.21^{e}	2.34 ± 0.19^{d}	2.60 ± 0.31^{c}	3.61 ± 0.51^{a}	3.55 ± 0.63^{b}	1.73 ± 0.44^{f}	-

*Values with different superscripts in a column and a row indicate significant differences ($p<0.05$)

high when compared to previous studies (Weliange and Amarasinghe, 2001; Barson and Marshall, 2003; Rolbiecki, 2006). However, mean intensity values determined in this study were in agreement of the findings of Yavuzcan *et al.* (2003) and Ergonul and Altindag (2005).

CONCLUSION

The plerocercoids of *L. intestinalis* may normally be expected to have a negative influence on tench population in Beysehir lake. Thus, *L. intestinalis* was observed all over the year sampled with minimum 25.80% mean prevalence value. Even in longer fish groups prevalence reached 100%. It is obvious that *L. intestinalis* plerocercoids can have dramatic effects on somatic and gonadal growth, which may influence the population dynamics of tench. Hence, Kennedy and Burrough (1981) stated that *Ligula* has very rapid power of dispersal throughout a new host population. It can reduce the population density and allow the resumption of good growth rates. It may influence the whole balance of the fish population due to impaired competitive relations. This is of importance for Turkey when the economic aspects of fisheries income from tench export are considered. Furthermore it is necessary more detailed studies on the effects of *L. intestinalis* on fish reproduction, growth and and population dynamics.

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