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The Dynamics of the *Ligula intestinalis* (Cestoda: Pseudophyllidea) in Three Cyprinid Species [*Alburnus escherichii* Steindachner, 1897; *Gobio gobio* (Linnaeus, 1758) and *Squalius cephalus* (Linnaeus, 1758)] in Çamkoru Pond (Ankara-Turkey)

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Abstract

Pleurocercoids of the tapeworm *Ligula intestinalis* (Linnaeus, 1758) were recorded from three fish species [*Squalius cephalus* (Linnaeus, 1758)*, Alburnus escherichii* Steindachner, 1897 and *Gobio gobio* (Linnaeus, 1758)] in Çamkoru Pond (Sakarya Basin-Turkey). This is the first record of *L. intestinalis* from *G. gobio* in Turkey. Infection prevelance is lower for *S. cephalus* (7.07%) and *G. gobio* (7.5%) when compared to *A. escherichii* (25.71%). The age composition of infected individuals of *A. escherichii*, *G. gobio* and *S. cephalus*, populations was as follows: III-VII; IV-V and I-II. The parasitisation index varied in *A. escherichii* between 0 and 18%, in *G. gobio* between 0 and 11.07% and in *S. cephalus* between 0 and 3.57%. The aim of this study is to compare dynamics of *L. intestinalis* pleurocercoids in three fish species of Çamkoru Pond. For this purpose; prevelance and intensity of infection, age and sex compositions of infected populations, seasonality of infection, the length and weight range of host species have been obtained and compared with other studies.

INTRODUCTION

Ligula intestinalis (Cestoda) is a common intestinal parasite of many fish species in Turkey. Because of the harmful effects on fish host, *L. intestinalis* has been the subject of a number of studies. Plerocercoid larvae of *L. intestinalis* are common in *Squalius cephalus* (Previously known as *L. cephalus*) [1-5] and *Alburnus escherichii* (Alburnus sp.) [2,6,7]. But for the first time it was observed in *Gobio gobio* for Turkey. A thorough search of the helminthological literature in Turkey reveals no records of the occurrence of *L. intestinalis* in the gudgeon, *Gobio gobio* (Linnaeus, 1758) (Cyprinidae), although it has been reported from this host in Northern Ireland [8], in England [9].

The aim of the study is to compare dynamics of *L. intestinalis* pleurocercoids in three fish species of Çamkoru Pond (Çamlıdere-Ankara). For this purpose; prevelance and intensity of infection, age and sex compositions of infected populations, seasonality of infection, the length and weight range of host species have been obtained and compared with other studies.

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MATERIAL AND METHODS

The data analysed in this study concerns a population of *L. intestinalis* from Çamkoru Pond (Çamlıdere-Ankara) located on the Kadınboğazı Creek, 105 km northwest of Ankara with a surface area of 7 ha. Fish species were caught monthly with nets of various mesh sizes (10, 17, 23, 30, 40 and 50 mm) between August 2002 and August 2003. After the transfer to the Hacettepe University Natural Researches Laboratory in Çamkoru, immediately the fish were visually inspected for the presence of larval cestode infection in the body cavities and the cestodes were identifed according to Chubb et al, 1987 [10] as *Ligula intestinalis*. Initial results clearly indicated that the native fish species *(S. cephalus, A. escherichii, G. gobio*) were the intermediate host of *L. intestinalis* in Çamkoru Pond, so further analyses focused on this host-parasite system. Fish and pleurocercoids were respectively measured and weighed to the nearest 1.0 mm and 0.1 g. Age determination was carried out according to the method of Lagler [11]. Fish were dissected to determine the sexual state (immature, mature, female, male). The prevelance (percentage of hosts infected) and the intensity (number of parasites per infected host) of them were calculated. The parasitisation index (PI) (%PI) = (Parasite weight / fish weight minus parasite weight) x (100) [12] was established in infected individuals.

RESULTS and DISCUSSION

Prevelance and intensity of infection in different age groups of fish species are shown in Table 1. Seasonal variation in prevelance and intensity of infection are shown in Table 2.

A total of 11 *Cyprinus carpio*, 1 *Oncorynchus mykiss*, 470 *Tinca tinca,* 315 *A. escherichi*, 40 *G. gobio* and 368 *S. cephalus* were inspected for the presence of larval cestode infection in the body cavities. Pleurocercoids were not found in the mirror and common carp (*C. carpio*), tench (*T. tinca*) and rainbow trout (*O. mykiss*) which were introduced after reservoir construction. Pleurocercoids were detected in native cyprinid species (*A. escherichii,*

Table 1. Prevelance and intensity of infection in different age groups of fish species.

Age	*Alburnus escherichii*				*Gobio gobio*				*Squalius cephalus*			
	N	N'	Pr (%)	Int (np)	N	N'	Pr (%)	Int (np)	N	N'	Pr (%)	Int (np)
I									57	20	35.09	1.1 (22)
II	3	0	0	0	2	0	0	0	38	6	15.79	1.83 (11)
III	162	18	11.11	1.56 (28)	14	0	0	0	179	0	0	0
IV	40	7	17.5	1.57 (11)	10	2	20	2.5 (5)	46	0	0	0
V	49	24	48.98	2.79 (67)	8	1	12.5	3 (3)	17	0	0	0
VI	43	26	60.47	2.85 (74)	6	0	0	0	8	0	0	0
VII	16	6	37.5	2.5 (15)					11	0	0	0
VIII	2	0	0	0					5	0	0	0
IX									3	0	0	0
X									4	0	0	0
Total	315	81	25.71	2.41 (195)	40	3	7.5	2.67 (8)	368	26	7.07	1.27 (33)

N: Total number of individuals; N': Number of infected individuals; Pr : Prevelance (Percentage of hosts infected); Int: Intensity (number of parasites per infested host); np: number of pleurocercoids

Table 2. Seasonal variation in prevelance and intensity of infection.

Months	*Alburnus escherichii*				*Gobio gobio*				*Squalius cephalus*			
	N	N'	Pr (%)	Int (np)	N	N'	Pr (%)	Int (np)	N	N'	Pr (%)	Int (np)
Aug.02	35	12	34.29	2.42 (29)	0	0	0	0	48	5	10.42	1.4 (7)
Sep.02	13	6	46.15	1.83 (11)	5	0	0	0	28	5	17.86	1.2 (6)
Oct.02	16	0	0	0	3	0	0	0	46	1	2.17	1 (1)
Nov.02	23	1	4.35	1 (1)	5	0	0	0	17	0	0	0
Apr.03	60	21	35	2.9 (61)	5	0	0	0	28	3	10.71	1.67(5)
May.03	31	10	32.26	2.3 (23)	7	0	0	0	34	1	2.94	1 (1)
Jun.03	54	10	18.52	2.1 (21)	5	1	20	2 (2)	50	3	6	1 (3)
Jul.03	53	10	18.87	2.2 (22)	5	2	40	3 (6)	65	3	4.62	1 (3)
Aug.03	30	11	36.67	2.45 (27)	5	0	0	0	52	5	9.62	1.4 (7)
Total	315	81	25.71	2.41 (195)	40	3	7.5	2.67 (8)	368	26	7.07	1.27 (33)

S. cephalus and *G. gobio)*. The plerocercoid larvae of *Ligula intestinalis* has not been recorded before from *G. gobio* in the Turkey. Of 40 *G. gobio* examined in present study 3 (7.5%) contained plerocercoids. The prevelance of infection in *G. gobio* (Gudgeon) and *S. cephalus* (European Chub) populations in Çamkoru Pond were quite similar. The highest prevelance of infection was determined in *A. escherichii* (Anatolian bleak) (25.71%).

The age composition in present study of Anatolian bleak, Gudgeon, European chub, populations was as follows: II-VIII; II-VI, and I-X; Because of the large mesh size (≥10 mm), fish less than I year old for European chub populations and II year old for Anatolian bleak and gudgeon populations were not represented. The age composition of infected individuals of Anatolian bleak, Gudgeon and European chub, populations was as follows: III-VII; IV-V and I-II. Since host resistance and behavior dictate infection age, age range of infection in three fish species were different. The age composition of host fish species in previous studies was as follows: *Tinca tinca* in Mogan Lake, I-VII [13]; *Acanthobrama marmid* in Keban Dam Lake, I-II [14]; *L. cephalus* in Ivrindi Pond, I- V [3]. These differences in the age distribution of the infected populations may be due to sampling differences, feding habits of fish species, host resistance and ecological characteristics of the aquatic systems.

Overall, the prevelance in age group of Anatolian bleak was as follows for females, males, both sexes combined, respectively: age 3., 7.95% (female), 14.86% (male) and 11.11% (both sexes combined); age 4., 18.75% , 16.67% and 17.5%; age 5., 56.52%, 42.31% and 48.98%; age 6., 60.87% , 60% and 60.47%; age 7., 57.14%, 22.2% and 37.5% and the mean prevelance of all samples was 25.71%. Of all the infected Anatolian bleak examined, 41 were female, and 40 were male. The VI age group was dominant in the prevelance. Pleurocercoids were not observed in female specimens of *S. cephalus* and male specimens of *G. gobio*. The prevelance in age class of Gudgeon was as follows for female, respectively; age 4., 20%; age 5., 12.5%; and the mean prevelance of all samples was 7.5%. The IV age group was dominant in the prevelance. The prevelance in age class of European chub was as follows for age groups, respectively: age 1., 35.09% (immature); age 2., 15.79% (male). The mean prevelance of all samples was 7.07%. The I age group was dominant in the prevelance. Prevelance in three fish species is

variable and depends on demographic characteristics (size, sex, age) and host condition of populations in Çamkoru Pond.

The prevelance of infection in previous studies of host populations was as follows: *T. tinca* in Mogan Lake, 40.07% [13]; *Alburnus spp*., 1.5% and *Esox lucius*, 7.6% in different areas of Central Anatolia [6]; *Acanthobrama marmid* in Keban Dam Lake, 7.54% [14]; *Rhodeus amarus* in Sapanca Lake 35.40% [15]; *Ctenopharyngodon idella* in pond conditions 29.33% [16]; *L. cephalus* in Topçam Dam Lake 36.14% [17]; *L. cephalus* in Devegeçidi Dam Lake, 50% [18]. *L.. cephalus* in Ivrindi Pond, 21.11% [3], *Alburnus alburnus* in Porsuk Basin, 52.2% [19] and *A.escherichii* in Mogan Lake, 6.8% [7]. *T. tinca* in Beyşehir Lake, 52.99% [20]. *Platichthys flesus* in Dalyan Lagoon, 20% [21]. The differences in habitat and trophic position were found as major reasons for difference in parasite prevelance within and between species.

Overall, the number of pleurocercoids and intensity in age class of Anatolian bleak was as follows for both sexes combined, respectively: age 3., 28 (1.56); age 4., 11 (1.57); age 5. 67 (2.79); age 6., 74 (2.85); age 7., 15 (2.5) and the mean intensity of all samples was 2.41. The VI age group was dominant in the intensity. The number of pleurocercoids and intensity in age class of Gudgeon was as follows for both sexes combined, respectively; age 4., 5 (2.5); age 3., 3 (3).and the mean intensity of all samples was 2.67. The V age group was dominant in the intensity. The number of pleurocercoids and intensity in age class of European chub was as follows for both sexes combined, respectively: age 1., 22 (1.1); age 2., 11 (1.83). The mean intensity of all samples was 1.27. The I age group was dominant in the intensity. Host resistance and behaviour are the most important factors dictating variation in intensity of infection and parasite loads [22]. The different prevelance in three cyprinid species may depend on habitat preferences and trophic position.

The intensity range (min-max) of the infected individuals of Anatolian bleak, Gudgeon, European chub, populations according to season in Çamkoru Pond was as follows: 1 (November) – 2.9 (April); 2 (June) – 3 (July) ; 1 (October, May, June, July) – 1.67 (April). The infection prevalence of chub and bleak reached their peaks in September and July for Gudgeon. The season period of *L. intestinalis* was detected for *L. cephalus* in July-August in Devegeçidi Dam Lake, *Platichthys flesus* in September-November [21], All months in two years survey [20], All months except February and April [3]. The season period of *L. intestinalis* infection in Turkey differs from aquatic systems and host species. The season related host feeding, patterns availability of infected intermediate hosts, immunological and hormonal changes and temperature are the most frequently suggested causes for seaonal fluctuation in prevelance and abundance of parasitic infections [23].

The Fork length and weight range of the infected individuals of Anatolian bleak, Gudgeon, European chub, populations in Çamkoru Pond was as follows: 8.5 - 15.5 cm. and 8 - 46.3 gr.; 10.5 - 11.6 cm. and 22.9 - 30.1 gr.; 8 - 14.3 cm. and 8.3 - 41 gr. The length and weight range of the pleurocercoids of Anatolian bleak, Gudgeon, European chub populations in Çamkoru Pond was as follows: 1 - 24.2 cm. and 0.1 - 3.1 gr.; 4 - 15.4 cm. and 0.2 - 1.5 gr.; 2 - 13 cm. and 0.1 – 0.6 gr. No correlation existed between size of host fish species and number of plerocercoids. The parasitic index varied in anatolian bleak between 0 and 18%, in gudgeon between 0 and 11.07% and in European chub between 0% and 3.57%.

Some Native fish species are in decline in Turkey and especially some species of Genus *Gobio* and

Alburnus have become endangered due to a combination of introduction of exotic fishes, aquaculture, overexploitation, habitat degredations (Innal, pers. observation). Environmental factors causing fluctiations in prevelance of and the effect of this parasite on its intermediate host [24]. Pleurocercoids were detected under this study from native fish species in Çamkoru Pond. The highest prevelance was observed in *A. escherichii*. The presence of *L. intestinalis* has been affecting the population structures and stocks of native fish species.

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