

Seasonal prevalence of *Allocreadium isoporum* (Loos, 1894) (Digenea: Allecreadiidae) in *Oxynoemacheilus tigris* (Osteichthyes: Balitoridae) (Steindachner, 1897) from Murat River, Eastern Anatolia, Turkey

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Abstract. This study was conducted to determine the seasonal prevalence, and intensity of *Allocreadium isoporum*, which was founded as an endoparasite in *Oxynoemacheilus tigris*. A total of 136 host fishes was captured seasonally from Murat River near province of Bingol, Turkey, between from December 2012 to November 2013. During the study totally 209 parasites were recorded. The seasonal prevalence, and intensity, seasonal variation of sex and size of the host fish, the highest and lowest infection density, and larval and mature forms of *A. isoporum* ratio of the distribution were investigated. This study has been conducted to determine the infection parameters, of *A. isoporum* in *O. tigris* for the first time.

Key words: Murat River, *Oxynoemacheilus tigris*, *Allocreadium isoporum*, Eastern Anatolia, Turkey.

Introduction

Oxynoemacheilus tigris (Steindachner, 1897) is ecologically important tropical freshwater fish in the Tigris River system. It is known to have several synonyms; according to Fish Base, the latest accepted species name is *O. tigris* (Prokofiev 2009). These small fish are quite secretive, hiding under stones or in mud in slow flowing sections of rivers (Coad 2010). *Oxynoemacheilus* synonym genus *Orthrias* are recorded from the Tigris River system, from Fırat, Dicle, Ceyhan, Asi, South Syria, Kura, and Aras Rivers (Kuru 1975, Geldiay & Balik 2007, Çoban et al. 2013). It is carnivorous and feeds mainly on crustacean (Chandra & Haq 1986); due to its feeding habit, it is the final host of *A. isoporum* that prefers to consuming *Anabolia nervosa*, *Chaetopteryx villosa* (Trichoptera), and *Ephemera vulgata* (Ephemeroptera) as intermediate hosts (Luhe 1911).

This worm is a widely distributed intestinal parasite of a number of species of Cyprinids and some other fishes of the Palaearctic region, and it was reported that it is a European-type parasite species in freshwater fishes (Moravec 1992, Bray et al. 2012). *A. isoporum* has been reported from a few Cyprinids fish species in some freshwater basins in Turkey (Aydogdu et al. 2001, Koyun & Altunel 2007). No work so far has been initiated on seasonal aspects of this digenean parasite in inland freshwater of Anatolia. The aim of this study was to explore the prevalence and mean intensity of infestation with *A. isoporum*, and the seasonal variation of the infestation in relation to the sex and size of *O. tigris*.

Materials and methods

The Murat River is one of the most important large and long (722 km) tributaries of the Euphrates River in South East Anatolia of Turkey. The sampling locations in this study were located near Bingol province (38° 88' 22" N, 40° 56' 80" E, 1025 m). The fish samples were caught from slow flowing parts of the Murat River, at monthly intervals from December 2012 to November 2013. This study was conducted during the four seasons: winter (December-February), spring (March-May), summer (June-August), and autumn (September - November).

Captured fish from the local area of the river under study were kept in freshwater and brought to the laboratory of the Biology Department, Faculty of Science, Bingol University. A total of 209 parasites were found from 136 host fish, 61 male and 75 female. Fish were divided into three size classes; small, <60 mm length; medium, 60.1-70 mm; and large, 70.1> mm as depicted in Table 3. Every fish was measured; the total length, weight and the sex were determined internally. Fishes were examined mainly for endoparasites. The abdominal cavity of every host was opened, the intestine was separated from the other visceral organs and placed in a petri dish containing physiological saline, and the helminthes were found with the aid of a stereo microscope. The digeneans were washed in 0.6% saline solution, and fixed in 4% hot formaldehyde solution and 70% ethyl alcohol. They were stained and mounted according to Pritchard & Kruse (1982).

Infestations were calculated according to monthly distribution, seasons, host size, and sex. Identification of parasites was done according to (Daves 1946, Yamaguti 1958, Movsessian et al. 2004, Jones et al. 2005).

Results

Oxynoemacheilus tigris is the first faunistic record in the Murat River obtained with this study. Out of 136 examined fish (61 males and 75 females), only 71 (36 males and 35 females) were found to be infected with *A. isoporum*. A total of 209 parasites were collected from the intestinal tract of fish host. The parasites were recorded during the year; the highest prevalence (75%) was observed in August, whereas the lowest (25%) prevalence was observed in January. The highest intensity was in April (4.6), and the lowest intensity was in February (1.4), respectively, as given in Table 1.

Seasonal prevalence, intensity, and abundance of parasites were found to be different in each season. The highest prevalence and intensity were seen in summer (69.4%) and spring (3.7). In winter, prevalence (35.3%) and intensity (1.8) were lower. The abundance was higher during summer (2.3), as seen in (Table 2). The prevalence and intensity of infestation of *A. isoporum* were significantly different in each season. The prevalence, intensity, and abundance varied according to the size of the host. The highest prevalence (53.8-57.1), intensity (2.8-2.9), and abundance (1.6-1.7) were almost

Table 1. Monthly distributions of *A. isoporum* in *O. tigris* from Murat River

Months	NHE	NHI	NPC	Prevalence	Intensity	Abundance
December	10	4	8	40	2	0.8
January	12	3	6	25	2	0.5
February	12	5	7	41	1.4	0.6
March	11	6	18	55	3	1.6
April	9	5	23	56	4.6	2.6
May	12	5	18	42	3.6	1.5
June	12	9	29	75	3.2	2.4
July	12	7	22	58	3.1	1.8
August	12	9	33	75	3.7	2.8
September	12	6	19	50	3.2	1.6
October	12	8	20	67	2.5	1.7
November	10	4	6	40	1.5	0.6

NHE: Number of hosts examined, NHI: Number of hosts infested, NPC: Number of parasites collected.

Table 2. Prevalence, intensity, and abundance of *A. isoporum* in different seasons

Seasons	NHE	NHI	Prevalence	NPC	Mean intensity	Abundance
Winter	34	12	35.3	21	1.8	0.6
Spring	32	16	50	59	3.7	1.8
Summer	36	25	69.4	84	3.4	2.3
Autumn	34	18	52.9	45	2.5	1.3

NHE: Number of hosts examined, NHI: Number of hosts infested, NPC: Number of parasites collected.

Table 3. Infestation of *A. isoporum* in different size groups of *O. tigris*

Size group(mm)	NHE	NHI	NPC	Prevalence	M. Intensity	Abundance
<60	44	18	58	40.9	3.2	1.3
60.1-70	36	21	58	58.3	2.8	1.6
70.1>	56	32	93	57.1	2.9	1.7

NHE: Number of hosts examined, NHI: Number of hosts infested, NPC: Number of parasites collected.

Table 4. Prevalence, mean intensity, and abundance of *A. isoporum* in different sexes in different seasons

Seasons	Sexes	NHE	NHI	Prevalence	NPC	M. Intensity	Abundance
Winter	Male	18	8	44	15	1.9	0.8
	Female	16	4	25	6	1.5	0.4
Spring	Male	16	11	68	49	4.5	3.1
	Female	16	5	31	10	2	0.6
Summer	Male	14	11	79	45	4.1	3.2
	Female	22	14	64	39	2.8	1.8
Autumn	Male	13	6	46	12	2	0.9
	Female	21	12	57	33	2.8	1.6

NHE: Number of hosts examined, NHI: Number of hosts infested, NPC: Number of parasites collected.

Table 5. Adult and larval stages *A. isoporum* distribution in different seasons

Seasons	NPC	Adult	Larva	Adult (%)	Larva (%)	R (A/L)
Winter	21	8	13	38.1	61.9	0.6
Spring	59	18	41	30.5	69.5	0.4
Summer	84	40	44	47.6	54.4	0.9
Autumn	45	19	26	42.2	57.8	0.7

NPC: Number of parasites collected, R (A/L): Ratio (Adult / Larva)

equal in intermediate and large size classes, and the lowest prevalence was observed in small fish (Table 3). In cases of intensity were lower in intermediate, and abundance, were lower in small-sized fish.

The highest prevalence, intensity, and abundance were observed in male hosts in spring and summer, whereas they were observed in female hosts in summer and autumn, as given in Table 4. The maximum numbers of mature and immature worms were observed during summer. The distributions of mature and immature worms are shown in Table 5.

Discussion

In the present study, the host fish were highly infested with the adult and larval stages of *A. isoporum* and the study was conducted to determine the seasonal prevalence and infestation of this digenetic parasite in *Oxynoemacheilus tigris* in the

Murat River. The infection differed according to month, season, and size of the host. The prevalence and intensity depend on some factors such as parasite species, feeding habits of hosts, and water characteristics. They also depend on the presence of Trichoptera and Ephemeroptera, which are intermediate hosts of *A. isoporum* (Lühe 1911). Carnivorous fish were more susceptible to infestation because their food contains larval worms (Chandra & Haq 1986). Feeding habits of host fish change with the age and their environment. Many parasites complete their life cycle by using fish as a host of the developing larval form. Digenetic trematode was a well-known group of fish parasite that can infest the fish in either adult or larval forms. Most of them more than two hosts to complete their life cycle. In the adult stage, they infest mainly the internal organs such as the stomach, liver, intestine, and body cavity (Banu et al. 1993). The prevalence and intensity of parasites varied from 25% to 75% and from 1.4% to 4.6%, respectively, all the year along with 0.5-2.8 abundance. The prevalence was higher in June and August, intensity was higher in May, and abundance was higher in August and April. It might be due to the temperature, which has a greater influence on the reproduction of parasites. Hasan et al. (2006) found that parasitic infestation was more severe at 20.5-32.3°C temperature and 7.7-8.5 pH. Steinauer & Font (2003) revealed that parasite prevalence and intensity were higher in spring and lower in winter; abundance and prevalence peaked in summer. According to Stojanovski et al. (2012), the average intensity of infestation of parasite species in *Squalius squalus* from Ohrid Lake, the highest level was that of *A. isoporum* (5.83) throughout the year. In spring, as the fish start reproducing, they become weak and eat feed with metacercaria. *A. isoporum* reproduces throughout the year, but in spring it becomes more dominant in the host. The infestation of *A. isoporum* was higher in middle-size class (60.1 - 70 mm) fish, similar to the findings of Shakir et al. (2005), who stated that the mean intensity was higher in 31 - 60 cm size class of the fish than in 61-90 cm fish. Malek & Mobedi (2001) stated that the prevalence was higher in the middle-length host (*Capoeta capoeta gracilis*). It could be due to the middle-length fish consuming more food containing this parasite (Das 2003).

Alam et al. (2010) stated that the prevalence and the intensity were higher in female hosts. In this study, the infestation was nearly the same in both male and female fish. It can be said that both fish are similarly susceptible to parasitic infestation. The highest numbers of mature and immature worms were observed in summer. The ratio of adult and larval worms was also maximum (0.9) in summer, and the minimum (0.4) was in spring. These findings indicated that the seasonality of the infection is determined by ecological conditions in locality, mainly the water temperatures, the ecology, feeding, and behavior of the fish host throughout the year.

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