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Prevalence of helminth parasites in fishes (*Salmo trutta* and *Schizothorax plagiostomus*) in India

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Abstract

Ahmad, F.; Sheikh, B.A.; Sofi, O.M.; Sofi, T.A.: ***Prevalence of helminth parasites in fishes (Salmo trutta and Schizothorax plagiostomus) in India.*** *Rev. vet. 29: 1, 45-51, 2017.* In Gurez Valley of Jammu & Kashmir, India, 210 specimens of *Salmo trutta* and 126 of *Schizothorax plagiostomus* examined during the present study, 49 (23.33%) and 35 (27.77%) respectively were infected with different types of helminth parasites. The recovered parasites during the study include *Adenoscolex oreini and Rhabdochona guptii* in *S. trutta* with a prevalence of 16.19%; 19.52% respectively; and *A. oreini; R. guptii* and *Camallanus fotedari* in *S. plagiostomus* with a prevalence of 19.84%; 22.22% and 18.25% respectively. *A. orieni* was most prevalent in both hosts during summer (20% & 23.68%), followed by autumn, spring and winter with a prevalence of 18.96% & 19.44%, 11.53% &17.85% and 10% & 16.66% respectively. The same trend was observed in case of *R. guptii* where the prevalence was 24.28% & 26.31%, 20.68% & 25%; 15.38% & 21.42 and 13.33% & 12.50% during summer, autumn, spring and winter respectively and in case of *C. fotedari* from *S. plagiostomus* same trend of prevalence like 23.66%; 22.22%; 14.28 and 8.33 was observed during summer ; autumn; spring and winter respectively. The prevalence of infection of *R. guptii* was a bit higher than *A. oreini* and *C. fotedari*.

Key words: fishes, *Salmo trutta, Schizothorax plagiostomus,* helminth parasites**,** India.

Resumen

Ahmad, F.; Sheikh, B.A.; Sofi, O.M.; Sofi, T.A.: ***Prevalencia de helmintos parásitos en peces (Salmo trutta y Schizothorax plagiostomus) en India.*** *Rev. vet. 29: 1, 45-51, 2017.* En el Valle de Gurez (Jammu & Kashmir, India), de 210 especimenes de *Salmo trutta* y 126 de *Schizothorax plagiostomus* examinados durante el presente estudio, 49 (23,33%) y 35 (27,77%) respectivamente, estaban infectados con diferentes tipos de helmintos parásitos. Los parásitos recuperados durante el estudio incluyeron *Adenoscolex oreini* y *Rhabdochona guptii* en *S. trutta*, con una prevalencia de 16,19% y 19,52% respectivamente; y *Adenoscolex oreini*, *Rhabdochona guptii* y *Camallanus fotedari* en *S. plagiostomus*, con una prevalencia de 19,84%; 22,22% y 18,25% respectivamente. *A. oreini* fue más prevalente en ambos huéspedes durante el verano (20% & 23,68%), seguido por el otoño, primavera e invierno, con prevalencias de 18,96% & 19,44%, 11,53% & 17,85% y 10% & 16,66% respectivamente. *A. oreini* fue más prevalente en ambos huéspedes durante el verano (20% & 23,68%), seguido por el otoño, primavera e invierno, con prevalencias de 18,96% & 19,44%, 11,53% & 17,85% y 10% & 16,66% respectivamente. La misma tendencia se observó en el caso de *R. guptti*, donde el predominio fue de 24,28% & 26,31%, 20,68% & 25%; 15,38% & 21,42 y 13,33% & 12,50% durante verano, otoño, primavera e invierno respectivamente, y en el caso de *C. fotedari* del *S. plagiostomus*, las mismas tendencias de predominio, de 23,66%; 22,22%; 14,28% y 8,33% se observaron durante verano; otoño; primavera e invierno respectivamente. El predominio de infección de *R. guptii* fue algo superior que los registrados en *A. oreini* y *C. fotedari*.

Palabras clave: peces, *Salmo trutta, Schizothorax plagiostomus,* helmintos parásitos**,** India.

INTRODUCTION

Fish all over the world suffer from varieties of parasitic diseases that cause mortality in fish either directly or indirectly [21]. Other author stated that characters of the water body in which the fish live affects the parasitic fauna and also help in determination of parasitic community [41]. Helminth parasites belong to Trematodes, Cestodes, Acanthocephalans and Nematodes. Most of them complete their life cycle through intermediate host, majorly the piscivorous birds [33].

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Epidemiology is the study of diseases or infections in host populations and the factors that determine their occurrence. The relationship between fish and its parasites is greatly influenced by the environmental conditions and the availability of the intermediate hosts for proliferation and reproduction of helminth parasites. Thus the conditions for the fish to flourish and the conditions for the parasite to complete their life cycles, determine the intensity of the infection in a particular environment.

Parasitic distribution in fish hosts is affected by various factors which may include the environmental factors, the host, the locality, and others. Similarly the area under study being isolated and distinct in its features has shown the variability in the parasitic distribution as well. As such the prevalence of infection with regard to age and gender of the hosts, seasons of the year were taken into account.

The present research work was designed to determine the helminth parasites fauna of fish species in River Kishenganga of Gurez valley (India) and their status in parasite communities (prevalence, mean intensity, abundance). The fishes under examination for helminth parasite infestation were the Brown Trout (*Salmo trutta fario)* and Khont (*Schizothorax plagiostomus*) which were caught live from the River Kishenganga of Gurez at different study sites. After thorough examination, only one cestode and one nematode parasite from Brown Trout and one cestode and two nematode parasites from *S. plagiostomus* were recovered.

MATERIAL AND METHODS

Study area and sampling. Gurez is a valley located in the high Himalayas on banks of river Kishenganga, about 86 km from Bandipore and 123 km from Srinagar in northern Jammu and Kashmir, India. In northeast of Srinagar, the main valley of Gurez extends between (34^0 30′ to 34^0 41′ N latitudes) and (74^0 37′ to E 74^0 46′E longitudes) at an average altitude of about 2370 m.a.s.l (about 8,000 feet). It is surrounded on its north by Ladakh, by Bandipora on the south, by Ganderbal on its southeast and on the west by Kupwara with its peripheries touching Line of Control (LoC) that divides the states of India and Pakistan.

The valley is nestled among high towering peaks and lofty and glaciated snow capped mountains which are not just an unvarying landmass but show great differences in elevation, aspect, rock type, ruggedness and glacial work which coalesce to make contrasting land surfaces. Gurez is divided into three regions; Baghtor to Sharda Peeth, Baghtor to Abdullae Tulail, Chorwan to Burzil pass.

Fishes were collected from the study sites with the help of locals or personally by fish nets and were brought alive in medium sized containers containing water to the temporary laboratory maintained at Dawar, the capital of Gurez. On an average 40-45 specimens were collected and dissected on seasonal basis. Immediately after killing, the fishes were visually examined for any ectoparasite and then a thorough examination of the whole body for helminth infestation was done with the help of hand lens or dissecting microscope.

For the collection of endoparasites, the fishes were dissected mid-ventrally and before removing the internal organs, the body cavity was thoroughly examined for parasites. Various organs like liver, bladder, heart and others, were removed and kept in separate petridishes containing normal saline (0.65% NaCl).

The alimentary canal being the obvious part of entry for many kinds of parasitic infestations was removed completely and split open longitudinally and placed in petridishes containing saline water to which a few crystals of menthol were added so that the parasites which were firmly anchored to the lumen of the intestine were easily detached without causing any damage or distortion to the body of the parasite.

Other organs were examined in the same manner by dissection and teasing with the help of brushes and needles. However, maximum numbers of parasites were collected from the alimentary canal of fish. Parasites collected from each fish were counted separately and regular record of the collection was maintained.

Photography & photomicrography. The photographs were taken with the help of Sony Digital SLR Camera Model Number (DSLR-A200). Photomicrography was conducted with DP-12 Digital Camera attached to Olympus Research Microscope in the department of Zoology, University of Agriculture & Technology (Pantnagar, India).

Statistical analysis. The mean prevalence of each parasite and its percentage was calculated by using appropriate formula [38] and data were analyzed by analysis of variance (ANOVA). The whole data was fed into a Microsoft Excel 2010. A computer program (SPSS 11.5 for windows) and primer software was used for data analysis. Student's t-test was used for the analytic assessment.

The prevalence was calculated by dividing the number of animals harboring a given parasite by the total number of animals examined for a particular parameter. Percentage (%) to measure prevalence was also studied. The differences were considered to be significant when the p-value obtained was less than 0.05.

RESULTS

Overall prevalence. Out of 210 specimens of *S. trutta* and 126 specimens of *S. plagiostomus* examined during the present study, 49 (23.33%) and 35 (27.77%) respectively were infected with different types of helminth parasites. The recovered parasites during the study include *Adenoscolex oreini; Rhabdochona guptii* in *S. trutta* with a prevalence of 16.19%; 19.52% respectively; and *Adenoscolex oreini; Rhabdochona guptii* and *Camallanus fotedari* in *S. plagiostomus* with a prevalence of 19.84%; 22.22% and 18.25% respectively.

Table 1. Overall prevalence of helminth parasites of two fish species.

host	n	infected	uninfected	recovered parasites		
				Cestoda	Nematoda	p-value
S. trutta	210	49 (23.33%)	161	34 (16.19%)	41 (19.52%)	0.013
S. plag.	126	35 (27.77%)	91	26 (20.63%)	30 (23.80%)	0.013

Table 2. Prevalence of different helminths of two fish species.

parasites	examined		infected		% age	
	S. plag.	*S. trutta*	*S. plag.*	*S. trutta*	*S. plag.*	*S. trutta*
A. oreini			25	34	19.84	16.19
R. guptii	126	210	28	41	22.22	19.52
C. fotedari			23	-	18.25	-
			p= 0.000	p= 0.013		

Table 3. Mean intensity and relative abundance of helminth parasites of two fishes.

host	examined	infected	nº parasites	mean intensity	relative abundace
S. trutta	210	49 (23.33%)	407	8.24	1.92
S. plag.	126	35 (27.77%)	270	5.48	2.14

Table 4. Mean intensity of helminth parasites of two fishes.

host	Nº E	Nº I	Nº AO	Nº RG	Nº CF	MI of AO	MI of RG	MI of CF
S. trutta	210	49	154	250	-	3.14	5.10	-
S. plag.	126	35	96	109	65	2.74	3.11	1.85

(Nº E = n examined; Nº I = n infected; Nº AO = *A. oreini*; Nº RG = *R.guptii*; Nº CF = *C. fotedari*).

No acanthocephalan and trematode parasites were observed during the study period. However, the prevalence of recovered parasites was higher during late summers, followed by autumn in both cases (Tables 1 and 2).

The nematode parasite *R. guptii* was most prevalent (22.22%) followed by *A. oreini* and *C. fotedari* with the prevalence of 19.84% and 18.25% respectively.

In 49 (23.33%) infected specimens of *S. trutta* and 35 (27.77%) infected specimens of *S. plagiostomus,* the mean intensity and relative abundance of 8.24 & 1.92; 5.48 & 2.14 respectively was observed. In *S. trutta*, the mean intensity of *A. oreini* & *R. guptii* was 3.14 & 5.10 respectively, and in *S. plagiostomus*, the mean intensity of *A. oreini, R. guptii* & *C. fotedari* was 2.74, 3.11 & 1.85 respectively (Tables 3 and 4).

Season wise prevalence. Referring to the seasons, it was observed that seasons do play a great role in distribution of helminth parasites in this beautiful valley. Although there was a less or moderate type of infection observed as compared to Kashmir valley water bodies. The prevalence of infection was almost similar but higher during summer and autumn than in spring. However there was a very low prevalence of infection during winters.

A. oreini was most prevalent in both hosts (*S. trutta* & *S. plagiostomus*) during summer (20% & 23.68%), followed by autumn, spring and winter with a prevalence of 18.96% & 19.44%, 11.53% & 17.85% and 10% & 16.66% respectively.

The same trend was observed in case of *R. guptii* where the prevalence was 24.28% & 26.31%, 20.68% & 25%; 15.38% & 21.42% and 13.33% & 12.50% during summer, autumn, spring and winter respectively and in case of *C. fotedari* from *S. plagiostomus* same trend of prevalence like 23.66%; 22.22%; 14.28% and 8.33% was observed during summer; autumn; spring and winter respectively.

The prevalence of infection of *R. guptii* was a bit higher than *A. oreini* and *C. fotedari* (Table 5). Hence the results obtained indicate that seasonal variations do play a significant role in helminth infestation in the study area.

Age wise prevalence. In order to study the relation between age and prevalence of helminth infection in fishes, the examined specimens were categorized into three groups: less than one year, 1-2 years, and above 2 years. It was observed that the prevalence was higher in age group of 1-2 years *i.e.,* 18.51% & 22.80% in *A. oreini* and 22.22% & 24.56% in *R. guptii* followed by age group of above 2 years *i.e.*, 16.66% & 20.45% and

Table 5. Seasonal prevalence of helminth parasites in two fish species.

season	examined		infected					p
			A. oreini		*R. guptii*		*C. fotedari*	
	S. trutta	*S. plag.*	*S. trutta*	*S. plag.*	*S. trutta*	*S. plag.*	*S. plag.*	
spring	52	28	6 (11.53)	5 (17.85)	8 (15.38)	6 (21.42)	4 (14.28)	0.001
summer	70	38	14 (20)	9 (23.68)	17 (24.28)	10 (26.31)	9 (23.66)	0.018
autumn	58	36	11 (18.9)	7 (19.44)	12 (20.68)	9 (25.00)	8 (22.22)	0.007
winter	30	24	03 (10)	4 (16.66)	04 (13.33)	3 (12.50)	2 (8.33)	0.012
total	210	126	34 (16.1)	25 (19.6)	41 (19.52)	28 (22.22)	23 (18.25)	

Numbers in parenthesis are in percentages.

Table 6. Age wise prevalence of helminth parasites in two fish species.

age years	examined		infected					p
			A. oreini		*R. guptii*		*C. fotedari*	
	S. trutta	*S. plag.*	*S. trutta*	*S. plag.*	*S. trutta*	*S. plag.*	*S. plag.*	
<1	60	25	07 (11.66)	3 (12.00)	08 (13.33)	4 (16.00)	3 (12.00)	0.006
1-2	108	57	20 (18.51)	13 (22.80)	24 (22.22)	14 (24.56)	12 (21.05)	0.015
>2	42	44	07 (16.66)	9 (20.45)	09 (21.42)	10 (22.72)	8 (18.18)	0.019
total	210	126	34 (16.19)	25 (19.64)	41 (19.52)	28 (22.22)	23 (18.25)	

Numbers in parenthesis are in percentages.

Table 7. Gender wise prevalence of helminth parasites in two fishes.

sex	examined		infected					p
			A. oreini		*R. guptii*		*C. fotedari*	
	S. trutta	*S. plag.*	*S. trutta*	*S. plag.*	*S. trutta*	*S. plag.*	*S. plag.*	
male	80	56	12 (15)	11 (19.64)	15 (18.75)	12 (21.42)	10 (17.85)	0.014
female	130	70	22 (16.92)	14 (20.00)	26 (20.00)	16 (22.85)	13 (18.57)	0.012
total	210	126	34 (16.19)	25 (19.64)	41 (19.52)	28 (22.22)	23 (18.25)	

Numbers in parenthesis are in percentages.

21.42% & 22.72% in *S. trutta* and *S. plagiostomus* respectively.

However, low prevalence was observed in the age group of below one year *i.e.*, 11.66% & 12% and 13.33% & 16% of *A. oreini* and *R. guptii* respectively. Further in case of *S. plagiostomus*, a prevalence of 21.05%; 18.18% and 12% of *C. fotedari* in the age group of 1-2 years, above 2 years and below 1 year was observed respectively (Table 6).

Gender wise prevalence. Out of 210 specimens of *S. trutta* examined during the study period, 80 were males and 130 were females. After examination it was observed that both sexes were almost equally infected with helminth parasites. A prevalence of 15% and 18.75% (*A. oreini* and *R. guptii* respectively) in males and 16.92% and 20% (*A. oreini* and *R. guptii* respectively) in females was observed during the present study.

In case of *S. plagiostomus* a total of 126 (56 males and 70 females) were examined. A prevalence of 19.64%; 21.42% and 17.85% in males and 20%; 22.85% and 18.57% in females of *A. oreini*; *R. guptii* and *C. fotedari* respectively was observed during the study period. Thus a slight remarkable difference of infection with regard to sex of the host was observed (Table 7).

DISCUSSION

The present results are in accordance with authors who stated that the parasitic infection can increase from moderate to severe levels depending upon the quality of water [36] . Others reported that the pollution of water bodies have led to more parasitic infestation of the host due to the presence of more intermediate hosts which subsequently affected the growth, development and survival of fish [39] . Some investigators also stated that quality of water has a potential to affect the health of a fish directly [22] .

In the current study, prevalence of nematode parasite *Rhabdhochona* species was 22.22 and 19.52% which is in accordance with other studies [32, 37] . Other investigators [19] while working on Tenderfoot Lake and Morris Lake also found that, Tenderfoot Lake being more polluted have much higher content of chlorophyll A, providing a much better habitat for snails which act as the intermediate hosts for most of the parasitic diseases, thus having more parasitic infection as compared to Morris Lake.

Previous works also stated that increase in parasitism in the Channid fish species due to increase in the organic pollution status of the river [11] . They stated that human impacts on the aquatic environment affect the health of the resident fish fauna, eventually causing disease and associated mortalities. Another publication revealed that nematodes are more prevalent than the other parasites [3] .

It was reported overall prevalence of fish parasites as 58%. The intensity of parasite varies from 1-9.2%. Other investigations reported high prevalence of *Rhabdochona* spp. in *Xiphophorus melinche* [4] . It was published high prevalence of nematode parasites in a pool of fishes [30] .

These findings of high prevalence during summer agree closely with the agro-climatic conditions of Gurez valley. The valley has a temperate climate marked by well-defined seasonality, consisting of four different seasons with wide variations in temperature and other weather conditions that influence the occurrence of parasitic infection in fishes.

An investigator attributed incidence of infection with feeding habits of the fish and availability of intermediate host in the habitat. Authors while working on the cultured carp in Sanami district Japan [27] discussed the role of temperature on the hatching of eggs and reported that no coracidium formation occurs during winter and spring seasons, thus attributing the lowest incidence in these seasons [2] ; hence supporting the present investigation.

Abundance of *Cystidicoloides tenuissima* in the infected fish varied from peak in summer to low in winter as worked out by others [13]. Also, it was reported maximum nematode infection in hill stream fish in the summer and a decline in winter [8]. Authors also reported high prevalence of helminth parasites in hill stream fishes during late spring and summer [9], as well as the incidence of *Procamallanus heteropneustus* highest in June which clearly supports the present observations [16].

Others reported the distribution pattern of the helminth populations in different fish hosts, which exhibited a regular seasonal trend and the infra-population concentration was relatively greater during summer [23]. *Rhabdochona kidderi* occurred in fishes with the highest values of prevalence and mean intensity from April to June [7], which is in agreement with the present study.

The variation in prevalence rates depends on the life cycle pattern of the parasite, availability of intermediate and definitive hosts, and the climatic conditions particularly water temperature. Investigators while working on seasonal and yearly population dynamics of two exotic helminths observed that in *Camallanus cotti* prevalence and mean abundance were higher in Hawaiian summer (47.7%) than in winter [40]. Others reported that the prevalence of helminths in Cyprinid fish *Labeo rohita* at river Song Jhrakhand was highest in May/June and lowest in winter [35].

Previous studies reported that the prevalence of infection was higher during summers followed by winters and less in monsoons [5]. Further they reported that the environmental factors and feeding habitat influence the seasonality of parasitic infection eithr directly or indirectly. Others revealed that summers are more favorable for parasites than the winters [12].

The present findings of helminth parasite infestation with regard to age of the host, has shown a marked increase with advancement of age. However age resistance has hampered the intensity of infection to a moderate level. This can be attributed to many factors, viz., exposure time to different intermediate hosts, increase in body length and immunity with advancement of age. The above observations are in conformity with numerous findigns [1, 10, 14, 15, 17, 18, 24, 25, 26, 28, 29]. Another investigators studied the factors shaping the parasite communities of trout-perch found that the most prevalent parasite species increased with host age, relating to increased food intake and (or) shifts in dietary preference towards larger food items [26]. Also, it was observed varying results in the parasitic abundance in different length groups of fish, which was attributed to the changes in the feeding at different ages of the host [1].

Investigators have found an increase in mean worm burden with an increase in fish length [15]. The increased prevalence with increase in fish length may be due to the increase in growth of the internal organs of the hosts leading to the increase in the surface areas of infection [10, 14, 18] or could be due to the exposure time of infection [26]. Some investigators, while working on dynamics of *Pseudodactylogrus anguilla* in Eel, *Anguilla anguilla* (England), found that there exists a positive correlation between host size and parasitic burden [29]. They found higher infection levels in larger fish.

Others made a general survey on certain helminth parasites infecting some Nile fishes at El-Mansoura, Egypt and found that the length of the fishes is positively correlated with the prevalence of infection [24]. That means with increase in length there is the corresponding increase in the prevalence of infection. Prevalence was found to increase as the fish grows, and could be attributed to the longer time of exposure to the environment by body size. was also reported [25].

An study demonstrated that increase in the size of fish host was accompanied with an increased parasitic infection [17]. The large fishes (<15 cm) were more heavily infected than the smaller fishes (>10 cm). The increase in the invasion index and mean intensity with the increased size (length) of the host, is attributed to two factors. Firstly the increased volume of food ingested by large fishes including the intermediate hosts and secondly due to the accumulation of plerocercoids in fish as they grow and it is accepted that the plerocercoids may survive in fish for several years.

Publications reported that small fishes are more susceptible to parasitic infection than the larger ones [6]. The above results indicates that the sex of the host does not show any remarkable difference in helminth parasitic infection, however the slight increase of infection in females can be attributed to their physiological and reproductive functions.

The p value 0.05 as observed in this case with regard to gender of the fish is less than 0.05, thus clearly showing significant relationship between gender and helminth infection which is in accordance to the studies done by another investigators [31], who reported similar rates of infection in both the sexes. Parasites may also alter the physiological as well as reproductive functions of hosts. This may also lead to decreased growth of fish [20].

An investigator reported that the infection rate varied in different sexes in *Schizothorax* spp. but the calculated chi-square value (M2 = 1.33) was found lower than the tabulated value which indicated that there is no significant relationship between helminth infection and the sex of host [34]. The low prevalence might be due to low consumption of intermediate hosts. A publication [6] reported males with higher prevalence than females.

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