



Evaluation of ecto and endo parasitic fauna of *Schizothorax plagiostomus* inhabitants of river Swat, Khyber Pakhtunkhwa, Pakistan

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Abstract

Fish is consumed as a rich and cheaper source of white meat and proteins all over the world. Fish farming is the leading source of income generation throughout the world. The present research study was conducted with aims to investigate the ecto and endo parasitic fauna of *S. plagiostomus* (snow trout) in River Swat. A total of 96 fish samples were collected on monthly basis from July-2018 to February-2019, from upper, middle and lower reaches. Fish samples were collected with the help of cast net, hand net and fishing rods. Local fishermen and experts help were also sought out for fish collection. 61 out of 96 fishes were found infected by helminth parasites. The total prevalence and intensity of 63.54% and 2.90 was observed respectively during data analysis. Highest monthly prevalence of 83.33% was recorded during July and August, while lowest prevalence of 33.33% was noted during February. Five species of helminths parasites were detected from *S. plagiostomus*, of which two were trematodes (*Rhabdochona schizothoracis* and *Rhabdochona* species), one species of Monogenia (*Diplozoon paradoxum*), one species of Cestodes (*Nippotaenia* species), and one species of Acanthocephalan (*Neoechynorhynchus devdevi*). Highest parasite wise prevalence, intensity and relative density of 21.87%, 4.09 and 0.895 was noted for *R. schizothoracis* while the lowest prevalence, intensity and relative density of 4.16%, 1.25 and 0.052 was noted for *N. devdevi*. Highest infection of 76.08% was observed in adults host while lowest, 40% infestation rate was observed in young fish samples. 73.68% prevalence was observed in female hosts while only 56.90% prevalence was observed in male individuals. Higher infection (83.33%) was noticed during summer season, while lowest infection (44.44%) was observed during winter season. Similarly 71.79% fishes were found infected that were collected from lower reaches of the River Swat than the fish samples collected from upper reaches (52%).

Keywords: intensity, prevalence, helminth parasites, river Swat.

Avaliação da fauna ecto e endoparasitária de *Schizothorax plagiostomus* habitantes do rio Swat, Khyber Pakhtunkhwa, Paquistão

Resumo

O peixe é consumido mundialmente por ser uma fonte rica e barata de carne branca e proteínas. A piscicultura é a principal fonte de geração de renda em todo o mundo. O presente estudo foi conduzido com o objetivo de investigar a fauna ecto e endoparasitária de *S. plagiostomus* (truta da neve) no rio Swat. Foram coletadas mensalmente 96 amostras de peixes, no período de julho de 2018 a fevereiro de 2019, nos trechos alto, médio e baixo com auxílio de redes de arrasto, redes de mão e varas de pesca. Pescadores locais e especialistas também ajudaram na coleta de peixes. Dos 96 peixes encontrados, 61 estavam infectados por parasitas helmintos. A prevalência de 63,54% e a intensidade total de 2,90 foram observadas durante a análise dos dados. A maior prevalência mensal de 83,33% foi registrada nos meses de julho e agosto, enquanto a menor, de 33,33%, em fevereiro. Cinco espécies de parasitas helmintos foram

detectadas de *S. plagiostomus*, dos quais dois eram trematódeos (espécies *Rhabdochona shizothoracis* e *Rhabdochona*), uma espécie de monogenia (*Diplozoon paradoxum*), uma espécie de cestódeos (espécie *Nippotaenia*) e uma espécie de acantocéfalo (*Neoechynorhynchus devdevi*). As maiores prevalências de parasitas (21,87%), intensidade (4,09) e densidade relativa (0,895) foram observadas em *R. schizothoracis*, enquanto as menores prevalências de parasitas (4,16%), intensidade (1,25) e densidade relativa (0,052), em *N. devdevi*. A infecção mais alta (76,08%) foi constatada em adultos hospedeiros, ao passo que a taxa de infestação mais baixa (40%) foi encontrada em amostras de peixes jovens. A prevalência de 73,68% foi verificada em hospedeiros do sexo feminino, enquanto a de 56,90%, em indivíduos do sexo masculino. Maior infecção (83,33%) foi observada durante a temporada de verão, e a menor infecção (44,44%), durante o inverno. Da mesma forma, 71,79% dos peixes encontrados infectados foram coletados no trecho baixo do rio Swat, enquanto 52%, no trecho alto.

Palavras-chave: intensidade, prevalência, parasitas helmintos, rio Swat.

1. Introduction

Schizothorax plagiostomus belongs to class actinopterygii, order cypriniformes and genus *Schizothorax*. It was named by Heckel 1838. Locally it is known as Swati fish in district Swat, KPK. It is found in cold water of snow-fed rivers and lakes all over the world. According to Bahuguna et al. (2009), *Schizothorax plagiostomus* is the most common fish, found in snow fed rivers, lakes and tributaries of Himalaya, Afghanistan, China, Pakistan, Nepal, Ladkha, Tibet, Bhutan and North-eastern part of India. *Schizothorax plagiostomus* is also used as a rich and delicious resource of food by the peoples of Himalayan area (Bahuguna et al., 2009).

Helminth parasites include Trematodes, Cestodes, Nematodes, and Acanthocephalans. These Helminth parasites harbor variety of fishes in the form of ecto and endo-parasites (Ahmad et al., 2014). Fish meat is a rich and cheaper source of proteins (Shafi et al., 2015). Peoples of underdeveloped and developing countries depend chiefly on fish meat for animal proteins and as a cheaper source of food (Dhar and Peerzada, 1989). Due to these valuable benefits, more attentiveness is being focus on fish inhabiting different kinds of water bodies throughout the globe (Becke et al., 2018). Fish of various rivers and lakes are infected by diverse nature of parasites, causing a variety of diseases in fish population (Boyd, 2003). Water pollution is the main cause of fish mortality in snow-fed and rain-fed rivers (Mishra et al., 2007; Ali et al., 2008; Dongdem et al., 2009; Buet et al., 2006).

These parasites impose great economics loss to fish populations. Alteration in environmental conditions is also a key source of wide range of diseases in fish fauna (Bagge and Valtonen, 1996; Shomorendra et al., 2005). Different kinds of helminthes parasites has been evaluated in the gills and intestines of *Schizothorax plagiostomus* in different regions of the globe (Bilqees et al., 2012; Shaikh et al., 2011; Moravec et al., 2010; Ahmed et al., 2007).

According to Ahmed et al. (2007); fish is used all over the world as a rich and cheaper source of white meat and proteins. Infection in fish body is a direct threat to its health and growth. Infection in fish is also an indirect threat to human morphology and physiology. So it is necessary that fish body must be maintained free of infections and

all necessary measurement should be taken for doing so. Due to its white meat and rich source of proteins, fish is consumed all over the world, and fish farming is the leading source of income generation throughout the world. This paper describes the diversity of ecto and endo parasitic fauna infecting *Schizothorax plagiostomus* inhabitant of rivers of Swat, Pakistan and to initiate awareness among the public not to put their garbage into the river Swat, because it will led to water pollution, water pollution will led to fish infections and fish infestation will led to human infection.

2. Material and Methods

2.1. Study area

Swat district lies between 34°-40 to 35° N latitudes and 72° to 74°-6 E longitudes. The total area of district swat is about 5337 Km² (2061 square miles). This region is surrounded in the West by districts Chitral, Upper Dir and Lower Dir, in the North by Gilgat-Baltistan, in East and South East by Kohistan, Buner and Shangla. The origin of this river begins in Kohistan region of Kalam from Mahodand, Ushu and Gabral, which are the main tributaries of this river. The basis of this river lies in the Hindukush Mountains and is fed by the water from glaciers on peak of the mountains and flow throughout the year in a narrow gap from Kalam to Madyan and lower plains of the valley up to Chakdara. River Swat join the River Panjkora at Sharbatti (Busaq Bridge), District Malakand. Finally the River Swat empties into River Kabul near District Charsadda. The total length of River Swat from Kalam to River Kabul is about 240 kilometer Figure 1.

2.2. Fish collection and processing

Schizothorax plagiostomus were collected from three sampling sites like upper, middle and lower regions of River Swat by cast net, hand net and fishing rods. Some fish samples were also collected from local market. Local fishermen and experts help were also sought out for collection of *S. plagiostomus* from sampling area. Surgical gloves were put on hands during collection and handling of fishes as a precautionary measure to avoid inters mixing of parasites if present, especially for ectoparasites. After collection 5% formalin were injected through mouth and anus into each fish sample.

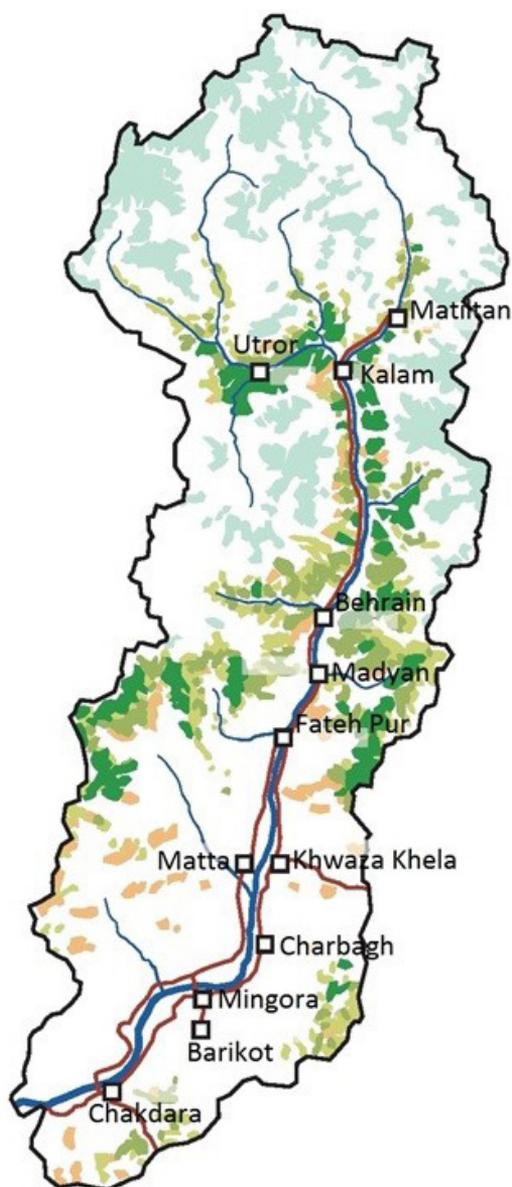


Figure 1. Map of river swat showing sampling area.

2.3. Fish identification

The collected fish samples were brought and identified in the lab of parasitology, department of Zoology, University of Malakand according to the standard keys described by Mirza and Sandhu (2007), Talwar and Jhingran (1992). Sexes of the collected host fish were also determined. The presence of tubercle on the head near snout indicate male individual. While if there is no tubercle on the snout region of fish then it will be a female individual. The abdomen of each fish specimen was pressed for the extrusion of whitish milt (for males) or eggs (for females). This strategy was used if the fish was in ripe or mature stage. The collected fish specimens were also dissected for sex identification. The presence of testes indicated male sex while the presence

of ovary confirmed female sex. The standard length (SL) of each specimen was recorded from snout to the caudal peduncle with the help of china tape and steel scale while the body weight (BW) was noted with the help of precisa balance model No.18220 Switzerland.

2.4. Parasite identification

Each sample of fish in the lab was investigated for external parasites with the help of magnifying glass/binocular microscope. Eyes, nostril, mouth and fins were examined for the presence of parasites. Gills were removed through scissor and were placed in a Petri dish with the help of forceps. Attached parasites to the gills were transferred to the dish with the help of fine brush. For the collection and identification of endo-parasitic fauna, *Schizothorax plagiostomus* were dissected mid ventrally in the lab with the help of surgical dissecting box. The alimentary canal of each specimen was cut into different parts like fore gut, mid gut and hind gut. These parts were also shaken carefully to dislodge the parasites if it is lying attached to the epithelial lining by hooks and suckers. The epithelial lining of stomach and intestine was also scraped with the help of penknife to remove the parasites if it is still attached to the internal covering. The surfaces of other visceral organs, body cavities and membranes were also examined for encysted larva and parasites by hand lens. The identification of different helminthes parasites in the host fish were carried out with the help of keys described by Eiras et al. (2000), Martins et al. (2007), Tavares-Dias et al. (2001) and Yamaguti (1961, 1963).

2.5. Statistical analysis

The prevalence, mean intensity and relative density of infection was calculated by the formula given by Ayaz et al. (2011) as: Prevalence rate (PR) = Number of host fish infected x 100 / number of host fish studied, Mean Intensity (MI) = Total number of parasites recovered/ Total number of infected host examined, Relative Density (RD) = Total number of parasites recovered / Total number of host examine. The relationship between the fish samples examined and that of infected was calculated by applying the GrapPad Prism Version 5. The value less than 0.05% at 95% CI was considered significant.

3. Result

The present study of ecto and endo-parasitic fauna of *Schizothorax plagiostomus* of River Swat was carried out on monthly basis from July 2018 to February 2019. A total of 96 fishes of *S. plagiostomus* were collected from various localities and reaches of river swat and were examined for the presence of external and internal parasites. A total prevalence of 63.54% (61/96) was determined. From the collected 96 fishes of *S. plagiostomus*; *Diplozoon paradoxum*, *Rhabdochona shizothoracis*, *Rhabdochona species*, *Nippotaenia species* and *Neoechynorhynchus devdevi* were collected. Overall prevalence of 63.54% was calculated for helminth parasites in *S. plagiostomus*. Highest parasite wise prevalence of 21.87% was recorded

for *R. schizothoracis*, followed by *D. paradoxum* 19.79%. While the lowest parasite wise prevalence of 4.16% was recorded for *Nippotaenia species*. Total intensity of 2.90 of helminth parasites was collected during the present work, while highest intensity of 4.09 was investigated for *R. schizothoracis* and lowest intensity of 1.25 was calculated for *Nippotaenia species*. Similarly overall relative density of 1.84 was recorded for helminth parasites. The highest relative density of 0.895 was calculated for *R. schizothoracis*, followed by *D. paradoxum*, while lowest relative density of 0.052 was investigated for *Nippotaenia species* (Table 1).

High prevalence of parasites was recorded in months of July and August 83.33%, followed by month of October 75%, September and November 66.66% (each), December 58.33%, January 41.66% and lowest was recorded in February 33.33%. This difference in prevalence of helminth parasites in different months was observed due to seasonal variations and environmental conditions of River Swat Table 2.

A strong correlation was observed between length and weight of *S. plagiostomus* and degree of infection. Prevalence, intensity and relative density of helminth

parasites increases with increase in the length and weight of host fish. This data show that prevalence, intensity and relative density of helminth parasites is higher 76.08%, 2.97 and 2.26 respectively in adults' hosts and lowest 40%, 2.0 and 0.8 in younger host fish (Table 3).

The total prevalence of 56.89%, intensity 2.21 and relative density 1.25 were recorded for male individuals, and prevalence of 73.68%, intensity 3.71 and relative intensity 2.73 was recorded respectively for helminth parasites in female individuals. In this way high rate of infection were observed in female individuals than male individuals (Table 4).

Highest rate of prevalence 83.33%, intensity 3.3 and relative density 2.75 was recorded during the summer season while lowest rate of prevalence 44.44%, intensity 2.68 and relative density 1.19 was recorded during the winter season (Table 5).

According to localities wise collection of the host, Fish samples collected from lower reaches have highest prevalence, intensity and relative density of 71.79%, 3.25 and 2.33 respectively than the prevalence, intensity and relative density of upper reaches 52%, 2.23 and 1.16 (Table 6).

Table 1. Overall and Parasites Wise Prevalence, intensity and relative density of Helminth Parasites in *S. Plagiostomus* of River Swat.

Name of the parasite	Host examined	Hosts infected	Prevalence %	Parasites observed	Intensity	Relative density
<i>Diplozoon paradoxum</i>	96	19	19.79	55	2.89	0.572
<i>Rhabdochona schizothoracis</i>		21	21.87	86	4.09	0.895
<i>Rhabdochona species</i>		11	11.45	21	1.91	0.218
<i>Nippotaenia species</i>		04	4.16	05	1.25	0.052
<i>Neoechinorhynchus devdevi</i>		06	6.25	10	1.67	0.104
Total		61	63.54	177	2.90	1.84

Statistical Analysis: P= 0.0001 95% CI= -74.37 to -93.23.

Table 2. Monthly Prevalence of Helminth Parasites Found in *S. plagiostomus* (Snow Trout) of River Swat from July, 2018 to February, 2019.

Name of the month	Hosts examined	Hosts infected	Prevalence %
July 2018	12	10	83.33
August 2018	12	10	83.33
September 2018	12	08	66.66
October 2018	12	09	75.00
November 2018	12	08	66.66
December 2018	12	07	58.33
January 2019	12	05	41.66
February 2019	12	04	33.33

Statistical Analysis: P= 0.0008 95% CI=2.536 to 6.214.

Table 3. Length and Weight Wise Prevalence, Intensity and Relative Density of Helminth Parasites in *S. Plagiostomus* of River Swat.

Length in cm	Weight in grams	Host observed	Host infected	Parasites collected	Prevalence %	Intensity	Relative density
10-20	100-150	15	06	12	40%	02	0.8
20.1-30	151-300	35	20	51	57.14%	2.55	1.45
30.1-45	301-800	46	35	104	76.08%	2.97	2.26

Table 4. Sex Wise Prevalence, Intensity and Relative Density of Helminth Parasites in *S. Plagiostomus* of River Swat, Khyber Pakhtunkhwa.

Sex of host	Host examined	Host infected	Parasites collected	Prevalence	Intensity	Relative density
Male	58	33	73	56.90%	2.21	1.25
Female	38	28	104	73.68%	3.71	2.73

Statistical Analysis: P= 0.1158 95% CI=-26.85 to 61.85.

Table 5. Seasons Wise Prevalence, Intensity and Relative Density of Helminth Parasites in *S. Plagiostomus* of River Swat, KP Pakistan.

Seasons	Host examined	Host infected	parasites recovered	Prevalence	Intensity	Relative Density
Summer July	24	20	66	83.33	3.3	2.75
August						
Autumn September	36	25	68	69.44	2.72	1.88
October						
November						
Winter December	36	16	43	44.44	2.68	1.19
January						
February						

Statistical Analysis: P= 0.0354 95% CI=-1.522 to 24.92.

Table 6. Locality wise prevalence (%), intensity and relative density in *S. plagiostomus* of River Swat, KP, Pakistan

Factor	Fish examined	Fish infected	Prevalence (%)	parasites recovered	Intensity	Relative density
Upper reaches	25	13	52	29	2.23	1.16
Middle reaches	32	20	62.5	57	2.85	1.78
Lower reaches	39	28	71.79	91	3.25	2.33

Statistical Analysis: P= 0.008 95% CI=10.23 to 13.10.

4. Discussion

In this research study a total of 96 host fish specimen were collected from different sites of River Swat. All the collected specimens of host fish were examined for the presence of ecto and endo-helminth parasites. After examination 61 out of 96 were found infected and total prevalence of 63.54% was calculated. Khan and Bilqees (1990); conducted a similar research study on helminth parasitic of fresh water fishes and calculated high prevalence rate for most of the helminth parasites. According to them some Cestodes have low prevalence rate but it is due to incomplete life cycle of these Cestodes and further transmission comes to an end. High prevalence rate 88.33% of helminth parasites was obtained during the months of July and August while lowest prevalence rate of 41.66% and 33.33% was recorded during the months of January and February respectively. Ahmad et al. (2014); conducted a similar study on the prevalence of helminth parasites in 115 fish samples of *S. plagiostomus* from river swat and observed similar finding. They calculated high prevalence rate during winter season which is in contradiction with the present study. Similar finding were observed by Ahmad et al. (2014) and Aydoğdu et al. (2011).

The parasites wise prevalence of five helminth parasites in host fish were calculated according to following order. High prevalence of *R. schizothoracis* 21.88% was recorded

followed by *D paradoxum* 19.79%, *Rhabdochona species* 11.45%, and *N. devdevi* 6.25% while the lowest value of 4.16% was recorded for *Nippotaenia species*. Ahmad et al. (2014); collected about 9 species of helminth parasites from 107 infected samples of *S. plagiostomus* and highest infection rate was noted for *R. schizothoracis* and *D. paradoxum* which is parallel with the finding of present study.

The overall intensity of 2.90 was calculated for helminth parasites. Highest parasite wise intensity of 4.09 was observed for *R. schizothoracis*, followed by *D. paradoxum* 2.89, *Rhabdochona Species* 1.91 and *N. devdevi* 1.67, while the lowest intensity of 1.25 was recorded for *Nippotaenia species*. A similar research study was conducted by Parween and Rahman (2000); maximum infection rate of 22.73% was noted in August and the lowest in February 4.55%. In their host fish, *Channa punctatus*, maximum infestation rate of 18.29% was documented in September and the lowest 6.86% in the month of March.

The overall relative density of 1.84 was observed for helminth parasites in *S. plagiostomus*. Highest value of relative density of 0.895 was observed for *R. schizothoracis* followed by *D. paradoxum*, 0.572, *Rhabdochona species* 0.218 and *N. devdevi* 0.104. While lowest relative density of 0.052 was observed for *Nippotaenia species*. The finding of Khurshid and Ahmad (2014), Leela and Rao (2014); are in accordance with the data observed in present study.

Highest infection rate of 76.08% was observed as the host fish grew in length and weight (Adult Host). While lowest prevalence rate of 40% was observed in young hosts. According to Omeji et al. (2014); with increase in weight and length of host fish, the prevalence of parasitic infection also increases. Present finding about length and weight of host fish is in accordance with the finding calculated by Bichi and Yelwa (2010); in fresh water fishes of Nigeria.

Female fish were found highly infected 73.68% than male 56.90%. The data collected during the present research agreed with the data collected about host gender by Amare et al. (2014). Similarly Omeji et al. (2014); also confirmed that female fish were highly infected with 57.5% infection rate and male are less infected with 42.4% infection rate.

The prevalence of infection during summer was 83.33%, 69.44% during autumn season, while 44.44% infection rate was observed during the winter season. Similarly Khurshed and Ahmad, 2014; studied *S. labiatus*, and observed highest prevalence in summer 39.5%, followed by autumn 19% and least prevalence rate 3.8%, was calculated in winter respectively.

Fish samples collected from lower reaches have highest prevalence 71.79%, intensity 3.25 and relative density of 2.33 than the prevalence 52%, intensity 2.23 and relative density of 1.16 of fishes collected from upper reaches. Similar finding were observed by Crisp et al. (2001).

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