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Helminth Infestations in Cold Water Fishes of Kashmir Himalayas

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ABSTRACT: A total of 40,000 acres of water resources, including lakes, streams, rivers, sars, springs, etc., are available in Jammu and Kashmir, making them ideal for fish farming. Aquaculture is one of the most economically significant applied strategies and one of the healthiest and most nutritious resources for people. These resources are experiencing a number of difficulties because of improper management and utilisation policy. One of the biggest obstacles to aquaculture is disease, which could eventually limit the commercial success of fish producers. The present study was carried out to evaluate the prevalence of endoparasitic helminths in *Schizothorax niger* and *Cyprinus carpio* during different seasons. The isolated parasites comprised *Pomphorhynchus kashmirensis, Bothriocephalus acheilognathi, Adenoscolex oreini* and *Neoechinorhycus manasbalensis*. According to the results of the current investigation, parasite occurrences are higher in the *Schizothorax* species than in the Carp species. A gradual increase in the prevalence rate coincided with a rise in temperature. Additionally, it was discovered that males had more parasite infestation than females. The red blood cell count, packed cell volume, and haemoglobin concentration of the infected fish all indicated a decline. However, infected fish displayed higher white blood cell levels when compared to uninfected fish.

Keywords: Helminth, *Shizothorax*, *Cyprinus*, Kashmir, Temperature.

INTRODUCTION

India today ranks second only to China in terms of yearly fisheries and aquaculture production, despite the fact that Asia accounts for more than 90% of global aquaculture production (De Jong, 2017). But in India, as in many other nations around the world, disease is a major impediment to aquaculture and a limiting factor for economic and socio-economic growth (Bagum *et al*., 2013). Even though parasitic infections are among the most critical issues affecting fish, the wild fish stock is often not very concerned because it doesn't seem like they suffer any noticeable consequences. Many fish parasites feed off the mucus, sloughed epithelial cells on the surface, or have attachment mechanisms that anchor the parasite in place on the skin surface rather than actually invading the tissues. Several variables, such as the host, the environment, the locality, and others, might influence the dispersion of parasites in fish hosts. Around the world, severe parasite illnesses are posing a challenge to the management of fish health and output. Innate defence mechanisms that are present in all teleost fish species prevent or lessen the severity of infection-causing parasite infections (Shah *et al*., 2015). They reduce fish production yield, lead to weight loss and decreased growth rates, transmit illnesses among humans and animals, delay fish sexual maturation, and raise fish mortality rates (Chandra, 2006). In both freshwater and marine habitats, helminths are a significant group of pathogens that infect and afflict fish (Jyrwa *et al*., 2016). There are between 20,000 and 30,000 helminth species documented globally, which significantly harm the fish sector (Kime, 1995). From the Kashmir valley, 31 species of helminth parasites were reported (Dhar, 1972). Fish helminths are classified into three major groups: Trematodes, Cestodes and Nematodes (Castro, 1996). Fish parasite infections are a major concern because they frequently result in immune system deterioration, making hosts more vulnerable to secondary infection by disease-causing agents, which devalues fish nutritionally and causes economic losses by posing marketing challenges for commercially exploited species (Onyedineke *et al*., 2010).

The goal of the current study was to identify the helminth parasites that infect different fish species in Kashmir Valley, India, as well as their position within parasite communities (prevalence, mean intensity, abundance and index of infection). In addition to this, haematological parameters were also assessed. Haematological technique is a frequent method for assessing the physiological status and health of fish (Fazio, 2019). In accordance with earlier research, various stressors and the length of exposure time have an impact on blood parameters; particularly stress markers (Hoseini *et al*., 2011; Park *et al*., 2008). The several species of Schizothorax and Craps were caught alive from the Dal Lake, Anchar, and Jehlum at various study sites were and examined for helminth parasite infestations.

MATERIAL AND METHODS

Study Area. Since the dawn of time, nature has provided the large population of the Kashmir valley with copious water supplies on which it depends in countless ways. At an average altitude of 1583 metres, Dal Lake is a Himalayan urban lake that is situated in the centre of Srinagar (34018/N latitude and 74091/E longitude).The spring Verinag, which is situated in the district of Anantnag at the base of the Panjal mountains, is the source of Jhelum, the principal river of Kashmir. Anchar Lake is a lake in the Srinagar district of Jammu and Kashmir, India, close to the Soura neighbourhood and not far from the city of Srinagar. The lake, which is close to Ganderbal, is connected to the well-known Dal Lake by the "Amir Khan Nallah" waterway. Since the turn of the century, there has been extensive urbanisation near these water sources, which has resulted in pollution, siltation from deforestation, and overexploitation of the numerous streams and lakes, many of which have shrunk to a small portion of their original size and have greatly degraded in water quality.

Sample collection and processing. Fish were procured from Dal, Anchar, and Jehlum on a monthly basis. In total, 120 *Schizothorax* fish and 120 carp were randomly selected each from Dal Lake, Anchar Lake, and Jehlum Lake. Fish were divided up based on species. The fish were then struck in the head, killing them. Fish were examined externally as soon as they were killed, and then their entire body surfaces underwent a careful examination. Fish were dissected mid-ventrally for internal investigation, and the entire body cavity was checked for helminth parasites. Then, normal saline worms were fixed in Carnoy's fixative, dyed with acetoalum carmine, dehydrated in escalating degrees of ethanol, cleaned in Xylene, and mounted in DPX. Visceral organs such as the alimentary canal, liver, kidney, and gall bladder were extracted and scanned separately. Isolated helminths were categorised using the keys supplied by Manwell (1961); Yamaguti (1959).

Parasite Examination:

Under mentioned formulae were used for parasite estimation:

Formula	Reference
$\text{Prevalence} = \dfrac{\text{Infected number of hosts}}{\text{Total no. of hosts examined}} \times 100$	Bhure *et al*. (2007)
$\text{Mean intensity} = \dfrac{\text{No. of parasites collected}}{\text{Total no. of infected hosts examined}}$	Gudivada and Vankara (2010)
$\text{Mean abundance} = \dfrac{\text{No. of parasites collected}}{\text{Total no. of hosts examined}}$	Gudivada and Vankara (2010)
$\text{Index of Infection} = \dfrac{\text{No. of hosts infected} \times \text{No. of parasites collected}}{\text{Total no. of hosts examined}}$	Dandawate (2020)

Estimation of haematological parameters: Each time, fish were given a 75 mg/L solution of clove oil as anaesthesia prior to blood collection. Every time, 200–500 l of blood were drawn and stored in sanitised Eppendorf tubes, which were then utilised for all of the subsequent haematological examinations. Utilizing the cyanmethaemoglobin technique, the haemoglobin content was calculated. At 590 nm, the level of colour development was visible. Using a hemocytometer, RBC and WBC were estimated (Karunasagar *et al.*, 1991) employing Neubaur's chamber, followed by the purpose of counting all the numbers below 40 X objective. Packed cell volume (PCV) was calculated using the Wintrobe's tube method (Ramnik,1994).

RESULTS

Level of infestation by parasites: The prevalence, intensity, abundance and index of infestation of isolated helminth *i.e*., *Pomphorhynchus kashmirensis*, *Bothriocephalus acheilognathi***,** *Adenoscolex oreini* and *Neoechinorhycus manasbalensis* are provided in Table 1-4 respectively. Fig. 1-4 also provide the graphical representation of prevalence of *Pomphorhynchus kashmirensis*, *Bothriocephalus acheilognathi***,** *Adenoscolex oreini* and *Neoechinorhycus manasbalensis* in exotic and endemic fishes in different water bodies of Kashmir. From the present study we can conclude that among the Carp and *Schizothorax* species, parasite incidences are more prevalent in *Schizothorax*. Also the results reveal that such infestations are more abundant in Anchar than in Jehlum and Dal Lake.

Seasonal variation of helminth infestations: *Pomphorhynchus kashmirensis*, *Bothriocephalus acheilognathi*, *Adenoscolex oreini*, and *Neoechinorhycus manasbalensis* all showed seasonal variations in their prevalence, with summer being the peak season. Temperature rise was accompanied by a steady rise in the prevalence rate. The seasonal prevalence of *Pomphorhynchus kashmirensis*, *Bothriocephalus acheilognathi*, *Adenoscolex oreini*, and *Neoechinorhycus manasbalensis* are depicted in Table 5-8 respectively.

Table 1: Total prevalence of *Pomphorhynchus kashmirensis.*

Host	Number of fishes examined	Infected number of fishes	Prevalence percentage	Number of parasites	Mean intensity	Abundance	Index
Dal Lake							
S. niger	38	8	21.05	14	1.75	0.37	2.95
C. carpio	41	6	14.63	12	2.00	0.29	1.76
Jehlum							
S. niger	35	9	25.71	18	2.00	0.51	4.63
C. carpio	39	7	17.95	13	1.86	0.33	2.33
Anchar							
S. niger	40	10	25.00	16	1.6	0.4	4.00
C. carpio	43	8	18.60	12	1.5	0.28	2.23

Fig. 1. Prevalence of *Pomphorhynchus kashmirensis* in water bodies.

Table 2: Total prevalence of *Bothriocephalus acheilognathi.*

Host	Number of fishes examined	Infected number of fishes	Prevalence percentage	Number of parasites	Mean intensity	Abundance	Index
Dal Lake							
S. niger	37	10	27.02	16	1.6	0.43	4.32
C. carpio	39	7	17.95	12	1.71	0.31	2.15
Jehlum							
S. niger	40	11	27.5	19	1.73	0.47	5.22
C. carpio	41	8	19.51	14	1.75	0.34	2.73
Anchar							
S. niger	36	12	33.33	19	1.58	0.53	6.33
C. carpio	39	9	23.08	16	1.78	0.41	3.69

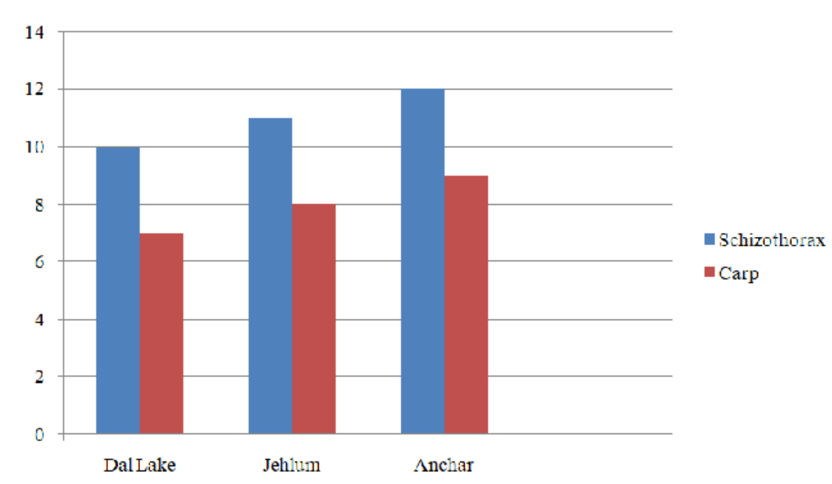

Fig. 2. Prevalence of *Bothriocephalus acheilognathi* in water bodies.

Table 3: Total prevalence of *Adenoscolex oreini.*

Host	Number of fishes examined	Infected number of fishes	Prevalence percentage	Number of parasites	Mean intensity	Abundance	Index
Dal Lake							
S. niger	42	13	30.95	16	1.23	0.38	4.95
C. carpio	39	9	23.08	14	1.55	0.36	3.23
Jehlum							
S. niger	41	14	34.15	19	1.36	0.46	6.49
C. carpio	43	10	23.25	14	1.4	0.32	3.25
Anchar							
S. niger	37	15	40.54	20	1.33	0.54	8.11
C. carpio	38	10	26.31	13	1.3	0.34	3.42

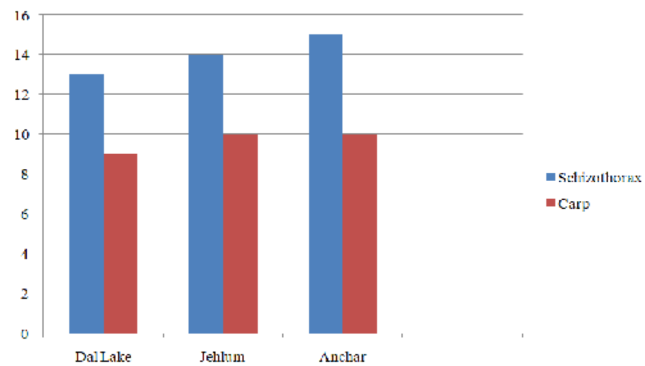

Fig. 3. Prevalence of *Adenoscolex oreini* in water bodies.

Table 4: Total prevalence of *Neoechinorhycus manasbalensis.*

Host	Number of fishes examined	Infected number of fishes	Prevalence percentage	Number of parasites	Mean intensity	Abundance	Index
Dal Lake							
S. niger	38	10	26.31	16	1.6	0.42	4.21
C. carpio	41	8	19.51	11	1.37	0.27	2.15
Jehlum							
S. niger	39	12	30.77	17	1.42	0.43	5.23
C. carpio	40	7	17.5	12	1.71	0.3	2.15
Anchar							
S. niger	40	14	35	19	1.36	0.47	6.65
C. carpio	43	9	20.93	13	1.44	0.30	2.72

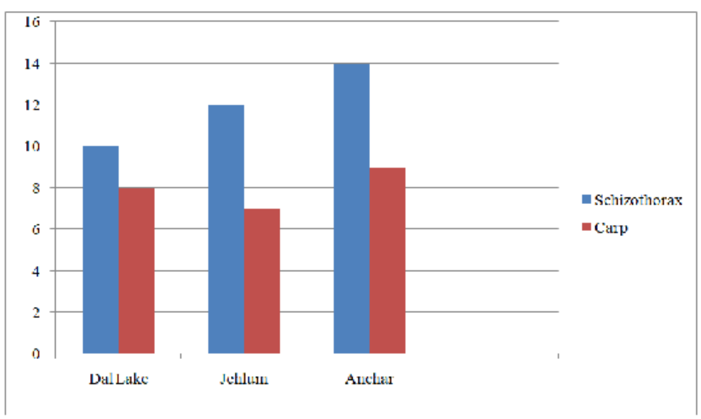

Fig. 4. Prevalence of *Neoechinorhycus manasbalensis* in water bodies.

Prevalence of helminths gender wise: The prevalence of *Pomphorhynchus kashmirensis, Bothriocephalus acheilognathi, Adenoscolex oreini,* and *Neoechinorhycus manasbalensis* was found elevated in males as compared to females as depicted in Table 9-12 respectively.

Table 5: Season wise prevalence of *Pomphorhynchus kashmirensis.*

Water body	Fish species	Spring				Summer				Autumn				Winter			
		P	MI	A	I	P	MI	A	I	P	MI	A	I	P	MI	A	I
Dal Lake	*S. niger*	36.36	1.5	0.54	2.18	22.22	1.5	0.33	0.67	10.00	3	0.3	0.3	12.5	2	0.25	0.25
	C. carpio	30	1.67	0.5	1.5	18.18	2	0.36	0.73	9.09	3	0.27	0.27	0	0	0	0
Jehlum	*S. niger*	40	1.75	0.7	2.8	33.33	2	0.67	2	12.5	3	0.37	0.37	12.5	2	0.25	0.25
	C. carpio	27.27	1.67	0.45	1.36	22.22	2	0.44	0.89	10	2	0.2	0.2	11.11	2	0.22	0.22
Anchar	*S. niger*	40	1.5	0.6	2.4	25	1.67	0.42	1.25	22.22	1.5	0.33	0.67	11.11	2	0.22	0.22
	C. carpio	27.27	2	0.54	1.64	20	1.5	0.3	0.6	16.67	1	0.17	0.33	10	1	0.1	0.1

Table 6: Season wise prevalence of *Bothriocephalus acheilognathi.*

Water body	Fish species	Spring				Summer				Autumn				Winter			
		P	MI	A	I	P	MI	A	I	P	MI	A	I	P	MI	A	I
Dal Lake	*S. niger*	40	1.5	0.6	2.4	33.33	1.67	0.55	1.67	25	1.5	0.37	0.75	10	2	0.2	0.2
	C. carpio	33.33	1.67	0.55	1.67	20	1.5	0.3	0.6	11.11	2	0.22	0.22	9.09	2	0.18	0.18
Jehlum	*S. niger*	50	1.2	0.6	3	25	1.67	0.42	1.25	20	2.5	0.5	1	9.09	3	0.27	0.27
	C. carpio	33.33	1.67	0.55	1.67	18.18	2	0.36	0.73	20	1.5	0.3	0.6	9.09	2	0.18	0.18
Anchar	*S. niger*	50	1.4	0.7	3.5	44.44	1.25	0.55	2.22	22.22	2	0.44	0.89	12.5	3	0.37	0.37
	C. carpio	33.33	2	0.67	2	30	1.67	0.5	1.5	22.22	2	0.44	0.89	9.09	1	0.09	0.09

Table 7: Season wise prevalence of *Adenoscolex oreini.*

Water body	Fish species	Spring				Summer				Autumn				Winter			
		P	MI	A	I	P	MI	A	I	P	MI	A	I	P	MI	A	I
Dal Lake	*S. niger*	50	1.2	0.6	3	33.33	1.25	0.42	1.67	18.18	1.5	0.27	0.14	22.22	1	0.22	0.44
	C. carpio	33.33	2.33	0.77	2.33	27.27	1	0.27	0.82	22.22	1.5	0.33	0.67	10	1	0.1	0.1
Jehlum	*S. niger*	54.54	1.17	0.64	3.82	44.44	1.25	0.55	2.22	30	1.33	0.4	1.2	9.09	3	0.27	0.27
	C. carpio	41.67	1.2	0.5	2.5	30	1.33	0.4	1.2	10	3	0.3	0.3	9.09	1	0.09	0.09
Anchar	*S. niger*	75	1.17	0.87	5.25	40	1.25	0.5	2	30	1.67	0.5	1.5	22.22	1.5	0.33	0.67
	C. carpio	40	1.25	0.5	2	37.5	1	0.37	1.12	18.18	1.5	0.27	0.54	11.11	2	0.22	0.22

Table 8: Season wise prevalence of *Neoechinorhycus manasbalensis.*

Water body	Fish species	Spring				Summer				Autumn				Winter			
		P	MI	A	I	P	MI	A	I	P	MI	A	I	P	MI	A	I
Dal Lake	*S. niger*	50	1.75	0.87	3.5	27.27	1.67	0.45	1.36	20	1.5	0.3	0.6	11.11	1	0.11	0.11
	C. carpio	30	1.33	0.4	1.2	22.22	1.5	0.33	0.67	9.09	2	0.18	0.18	18.18	1	0.18	0.36
Jehlum	*S. niger*	50	1.2	0.6	3	27.27	1.67	0.45	1.36	22.22	2	0.44	0.89	22.22	1	0.22	0.44
	C. carpio	23.33	1.67	0.55	1.67	16.67	2	0.33	0.67	10	2	0.2	0.2	11.11	1	0.11	0.11
Anchar	*S. niger*	45.45	1.4	0.64	3.18	40	1.25	0.5	0.2	30	1.33	0.4	1.2	22.22	1.5	0.33	0.67
	C. carpio	40	1.25	0.5	2	15.38	1.5	0.23	0.46	22.22	1.5	0.33	0.67	9.09	2	0.18	0.18

Table 9: Gender wise prevalence of *Pomphorhynchus kashmirensis*

Host	Gender	Number of fishes examined	Infected number of fishes	Prevalence percentage	Number of parasites	Mean intensity	Abundance	Index
Dal Lake								
S. niger	Male	21	5	23.81	9	1.8	0.43	2.14
	Female	17	3	17.65	5	1.67	0.29	0.88
C. carpio	Male	23	4	17.39	9	2.25	0.39	1.56
	Female	18	2	11.11	3	1.5	0.17	0.33
Jehlum								
S. niger	Male	19	5	26.31	11	2.2	0.58	2.89
	Female	16	4	25	7	1.75	0.44	1.75
C. carpio	Male	22	4	18.18	9	2.25	0.41	1.75
	Female	17	3	17.65	4	1.33	0.23	0.70
Anchar								
S. niger	Male	22	7	31.82	13	1.86	0.59	4.14
	Female	18	3	16.67	5	1.67	0.28	0.83
C. carpio	Male	24	5	20.83	8	1.6	0.33	1.67
	Female	19	3	15.79	4	1.33	0.21	0.63

Table 10: Gender wise prevalence of *Bothriocephalus acheilognathi.*

Host	Gender	Number of fishes examined	Infected number of fishes	Prevalence percentage	Number of parasites	Mean intensity	Abundance	Index
Dal Lake								
S. niger	Male	21	6	28.57	11	1.83	0.52	3.14
	Female	16	4	25	5	1.25	0.31	1.25
C. carpio	Male	21	5	23.81	9	1.8	0.43	2.14
	Female	18	2	11.11	3	1.5	0.17	0.33
Jehlum								
S. niger	Male	23	7	30.43	14	2	0.61	4.26
	Female	17	4	23.53	5	1.25	0.29	1.18
C. carpio	Male	24	5	20.83	9	1.8	0.37	1.87
	Female	17	3	17.65	5	1.67	0.29	0.88
Anchar								
S. niger	Male	20	8	40	13	1.62	0.65	5.2
	Female	16	4	25	6	1.5	0.37	1.5
C. carpio	Male	21	6	28.57	11	1.83	0.52	3.14
	Female	18	3	16.67	5	1.67	0.28	0.83

Table 11: Gender wise prevalence of *Adenoscolex oreini.*

Host	Gender	Number of fishes examined	Infected number of fishes	Prevalence percentage	Number of parasites	Mean intensity	Abundance	Index
Dal Lake								
S. niger	Male	24	8	33.33	11	1.37	0.46	3.67
	Female	18	5	27.78	5	1	0.28	1.39
C. carpio	Male	23	6	26.08	10	1.67	0.43	2.61
	Female	16	3	18.75	4	1.33	0.25	0.75
Jehlum								
S. niger	Male	23	8	34.78	13	1.62	0.56	4.52
	Female	18	6	33.33	6	1	0.33	2
C. carpio	Male	25	6	24	9	1.5	0.36	2.16
	Female	18	4	22.22	5	1.25	0.27	1.11
Anchar								
S. niger	Male	21	9	42.84	13	1.44	0.62	5.57
	Female	16	6	37.5	7	1.17	0.44	2.62
C. carpio	Male	21	6	28.57	8	1.33	0.38	2.28
	Female	17	4	23.53	5	1.25	0.29	1.17

Table 12: Gender wise prevalence of *Neoechinorhycus manasbalensis.*

Host	Gender	Number of fishes examined	Infected number of fishes	Prevalence percentage	Number of parasites	Mean intensity	Abundance	Index
Dal Lake								
S. niger	Male	21	7	33.33	12	1.71	0.57	4
	Female	17	3	17.65	4	1.33	0.23	0.70
C. carpio	Male	23	5	21.74	7	1.4	0.30	1.52
	Female	18	3	16.67	4	1.33	0.22	0.67
Jehlum								
S. niger	Male	22	7	31.82	11	1.57	0.5	3.5
	Female	17	5	29.41	6	1.2	0.35	1.76
C. carpio	Male	23	4	17.39	8	2	0.35	1.39
	Female	17	3	17.65	4	1.33	0.23	0.70
Anchar								
S. niger	Male	22	9	40.91	13	1.44	0.59	5.32
	Female	18	5	27.79	6	1.2	0.33	1.67
C. carpio	Male	24	6	25	9	1.5	0.37	2.25
	Female	19	3	15.79	4	1.33	0.21	0.63

Impact of helminths on blood components: The important blood parameters of infected and normal fishes are represented by Table 13. No standard trend was observed in haemoglobulin as it decreased in some while increased in others. Fish infested with *Pomphorhynchus kashmirensis, Bothriocephalus acheilognathi, Adenoscolex oreini* and *Neoechinorhycus manasbalensis* were recorded to show decreased haemoglobulin levels than the control. The fishes infested with these helminths showed decreased RBC and PVC levels than the fishes of control. WBC concentration was found be higher in parasite infected fishes than in normal ones.

Table 13: Blood parameters in helminth infested fishes.

Parameter	Control	Infested fish			
		Pomphorhynchus kashmirensis	*Bothriocephalus acheilognathi*	*Adenoscolex oreini*	*Neoechinorhycus manasbalensis*
Hb (g%)	9.54 ±1.93	9.06± 2.79	8.94±3.28	9.42±1.28	9.13±1.95
RBC ($x10^6$ mm^3)	2.64±1.82	2.37± 2.35	2.14± 1.29	1.94±3.52	2.37±1.68
WBC ($x10^3$ mm^3)	32.59±2.76	43.93±3.18	46.20±1.64	39.84± 2.37	41.1±2.61
PCV (%)	33.29±2.29	32.44±1.63	31.71±1.15	33.05±2.58	32.57± 0.16

DISCUSSION

Parasitic prevalence was found to be more in Anchar than Dal Lake and Jehlum. This could be as a result of declining water quality in anchar, which is mostly to blame for stress-inducing fish species. Fish are more vulnerable to parasite diseases under these stressful conditions (Hudha *et al*., 2021). Infection patterns of endoparasitic hehminths were greatly influenced by fish species, season, gender and water body. The prevalence of helminths was found more in males than in females. Seasonal changes, pathogen interactions, and parasites have an impact on fish physiology and immunity (Qayoom and Jaies 2019). In a previous study, Takemoto and Pavanelli (2000) found that male hosts had considerably more parasite intensity than female hosts. Susceptibility to illnesses may change depending on their gender, which may be due to genetic predisposition and hormonal regulation. Similarly, Qayoom and Shah (2017) from their study reported that *Pomphorhyncus kashmerensis* (Acanthocephalan) showed highest incidence in males of *Schizothorax plagiostomous* (pr. = 74.07%) followed by males of *Schizothorax niger* (pr. = 66.67%) and females of *Schizothorax niger* (64.29%). Similary Qayoom *et al.* (2015) while studying parasite prevalence reported higher abundance of *Pomphorhyncus* (pr. 27%, M. I. 3.91%, R. D. 0.27% and Ind. 56.97%) followed by *Neoechinorhyncus* (Pr.= 24%, M.I. = 2.77% R.D. = 0.66% and Ind. = 31.92%) and *Adenoscolex* (Pr. = 15.5%, M.I. = 3.00%, R.D. = 0.465% and Ind. = 14.41%) respectively.

Blood is a useful biomarker of an organism's health and is used as one of the haematological indicators to assess the health state of fish (Joshi *et al*., 2002). The haematological parameters of the examined infected and uninfected fish samples varied significantly during the course of the investigation. The decrease in haemoglobin, RBC count and packed cell volume in the infested fishes could be attributed to the anaemia resulting from the parasitic infestation (Martins *et al.*, 2004). The first line of defence against an infection is an increase in WBC levels. WBCs stimulate the immune system and haemopoietic tissues during parasitic infestation, creating antibodies and other chemicals that act as defences against infection (Lebelo *et al*., 2001).

CONCLUSION

Fish health and output management are becoming more difficult as a result of severe parasitic infections. Infections with fish parasites are a serious problem because they typically lead to immune system degradation, which makes hosts more susceptible to subsequent infection by pathogens. In the current investigation, Anchar was shown to have a higher prevalence of parasites. Fish species, the time of year, gender, and water body all have a significant impact on hehminth infection patterns. Additionally, males had a higher prevalence of helminths than females did.

Conflict of Interest. None.

REFERENCES

Bagum, N., Monir, M. S. and Khan, M. H. (2013). Present status of fish diseases and economic losses due to incidence of disease in rural freshwater aquaculture of Bangladesh. *Journal of Innov. Dev. Strategy*, *7*(3), 48-53.

Bhure, D. B., Jadhav, B. V., Pathan, D. M. and Padwal, N. (2007). Population index of some trematodes in fresh water fishes from Aurangabad. *Proceedings of 16th All India ZSI Conference, Fisheries and Fish Toxicology, 20*, 217- 219.

Castro, G. A. (1996). Chapter 86 Helminths: Structure, Classification. *Growth, and Development Flukes (Trematodes)*, 1-6.

Chandra, K. J. (2006). Fish parasitological studies in Bangladesh: A Review. *Journal of Agriculture and Rural Development, 4*, 9- 18.

Dandawate, R. R. (2020). Distribution of Helminth parasites and seasonal rate of infection in Clarias batrachus (Jerdon, 1849) fishes of Savitri River from Konkan region, Maharashtra, India. *GSC Biological and Pharmaceutical Sciences*, *11*(1), 127-131.

De Jong, J. (2017). Aquaculture in India. *Rijksdienst voor Ondernemen d Nederland*.

Dhar, R. L. (1972). *Studies on helminth parasites of fishes of Jammu & Kashmir* (Doctoral dissertation, Ph. D. Thesis, Srinagar, Kashmir: University of Kashmir).

Fazio, F. (2019). Fish haematology analysis as an important tool of aquaculture: a review. *Aquaculture*, *500,* 237-242.

Gudivada, M. A. N. I. and Vankara, A. P. (2010). Population dynamics of metazoan parasites of marine threadfin fish, *Polydactylus sextarius* (Bloch and Schneider, 1801) from Visakhapatnam coast, Bay of Bengal. *Bioscan*, *5*(4), 555-561.

Hoseini, S. M., Hosseini, S. A. and Nodeh, A. J. (2011). Serum biochemical characteristics of Beluga, *Huso huso* (L.), in response to blood sampling after clove powder solution exposure. *Fish physiology and biochemistry*, *37*(3), 567-572.

Hudha, J., uRehman, M., Qayoom, I., Bashir, S. and Ali, A. (2021). Indigenous Schizthoracine Fishes as Bioindicators of Parasitic Infections in Kashmir. *Biological Forum – An International Journal*, *13*(2), 426-432.

Joshi, P. K., Bose, M. and Harish, D. (2002). Changes in certain haematological parameters in a siluroid cat fish Clarias batrachus (Linn) exposed to cadmium chloride. *Pollution Research*, *21*(2), 129-131.

Jyrwa, D. B., Thapa, S. and Tandon, V. (2016). Helminth parasite spectrum of fishes in Meghalaya, Northeast India: a checklist. *Journal of Parasitic Diseases*, *40*(2), 312-329.

Karunasagar, I., Rosalind, G. and Karunasagar, I. (1991). Immunological response of the Indian major carps to *Aeromonas hydrophila* vaccine. *Journal of Fish Diseases*, *14*(3), 413-417.

Kime, D. E. (1995). Influence of aquatic environmental features on growth and reproduction of fish. *Reviews fish biology and fisheries*, *3*, 52-57.

Lebelo, S. L., Saunders, D. K. and Crawford, T. G. (2001). Observations on blood viscosity in striped bass, *Morone saxatilis* (Walbaum) associated with fish hatchery conditions. *Transactions of the Kansas Academy of Science*, *104*(3), 183-194.

Manwell, R. D. (1961). Introduction to Proto-Zoology. Edward Arnold (Publisher) Ltd. London.

Martins, M. L., Tavares-Dias, M., Fujimoto, R. Y., Onaka, E. M. and Nomura, D. T. (2004). Haematological alterations of *Leporinus macrocephalus* (Osteichtyes: Anostomidae) naturally infected by *Goezia leporini* (Nematoda: Anisakidae) in fish pond. *Arquivo Brasileiro de Medicina Veterinária e Zootecnia*, *56,* 640-646.

Onyedineke, N. E., Obi, U., Ofoegbu, P. U. and Ukogo, I. (2010). Helminth parasites of some freshwater fish from river Attlush in, Edo State, Nigeria. *Journal of American Science, 6*, 16-21.

Park, M. O., Hur, W. J., Im, S. Y., Seol, D. W., Lee, J. and Park, I. S. (2008). Anaesthetic efficacy and physiological responses to clove oil anaesthetized kelp grouper *Epinephelus bruneus*. *Aquaculture Research, 39*(8), 877-884.

Qayoom, I. and Jaies, I. (2019). Immuno-modulation in fishes against parasitic infections: A review. *Journal of Pharmacognosy and Phytochemistry*, *8*(4), 3560-3563.

Qayoom, I. and Shah, F. A. (2017). Parasitic Bioload in Schizothoracine Fishes of Kashmir Valley with Respect to the Trophic Status of Anchar Lake. *Research Journal of Agricultural Sciences*, *8*(2), 364-369.

Qayoom, I., Shah, F. A., Balkhi, M. H., Abubakar, A., Bhat, F. A., Kumar, A. and Bhat, B. A. (2015).incidence of helminth parasites in cold water fishes of river Jehlum, Srinagar, J&K. *The Ecoscan*, *9*(1/2), 11-16.

Ramnik S. 4th Ed. New Delhi: Jaypee Brothers; 1994. Medical Laboratory Technology; p. 187.

Shah, F. A., Qayoom, I., Balkhi, M. H. and Kumar, A. (2015). Impact of Parasitic Diseases on Fishes of North West Himalayan Streams. *Current World Environment*, *10*(3), 920.

Takemoto, R. M. and Pavanelli, G. C. (2000). Aspects of the ecology of proteocephalidcestodes parasites of *Sorubim lima* (Pimelodidae) of the upper Paraná River, Brazil: I. Structure and influence of host's size and sex. *Revista Brasileira de Biologia*, *60*, 577-584.

Yamaguti, S. (1959). System ahelminthumvol 1, 2, 3. The nematodes of vertebrates. New York: *interscience*.

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