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Seasonal variation in density, distribution, and related parameters of helminth parasites in Labeo rohita of the Ganga River at Arrah (Bihar)

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ABSTRACT

Background: The current investigation was conducted on the seasonal variations in the density, distribution, abundance, and intensity of helminth parasites in *Labeo rohita* collected from different sites along the Ganga River at Arrah, Bihar, India.

Materials and Methods: The host fish were found to parasitize five helminth parasites: *Euceradium* in the intestine, *Camallunus* in the stomach, *Dactylogyrus* and *Haplioceidus* in the gills, and *Gyrodactylus* in the skin. These parasites revealed seasonal fluctuation in their prevalence percentage, mean intensity, abundance, and index of infection..

Observations and Results: The yearly average prevalence of helminth parasites is 41.67%, with variations from 18.5% in winter to 61.0% in the monsoon. The mean abundance is 6.31, ranging from 2.52 in winter to 9.45 during the monsoon. The frequency index varies from 9.51 for the rare genus *Camallanus* to 33.03 for the common genus *Haplocleidus*. Additionally, the genus-wise frequency index ranged from 7.95 for *Camallanus* in winter to 33.48 for *Haplocleidus* in summer.

Conclusions: The observed seasonal variations have been attributed to temperature, feeding habits, and life patterns of the parasites. The present investigation concludes that the summer and monsoon seasons are the most susceptible seasons to parasitic attacks in *Labeo rohita*

Keywords: *Parasites, Prevalence, Intensity, Abundance, Labeo rohita*

1. INTRODUCTION

Parasites are important pathogens that cause infections and disease in fish. In reality, parasite infections are becoming a serious threat to fish health and production. It is a crucial issue for aquatic biologists to address to achieve sustainable aquaculture production. Parasitic infestations account for 78% of diseases in Indian freshwater aquaculture and cause significant economic loss [1]. Due to parasite infestations and resulting diseases, fish producers in Andhra Pradesh and West Bengal have experienced productivity losses of 21% and 26%, respectively [2,3]. In most fish farms, parasite infestation has been the most concerning of all fish pathogens due to its high morbidity and slow growth rate. These parasites were difficult to remove from the culture system, resulting in a serious setback for freshwater aquaculture. These parasites proliferate rapidly in poor water quality circumstances [4] or stressful environments [5], causing significant morbidity in fish [6].

The current study aims to investigate the impact of seasonal variation in helminth density, distribution, and related parameters in *Labeo rohita* from several selected sites of the Ganga River at Arrah, Bihar.

2. MATERIALS AND METHODS

The study was conducted at the Department of Zoology, Maharaja College, Ara. Bihar, India. 1800 specimens of *Labeo rohita* were collected from the following five sites (Bakhorapur, Sinha Ghat, Babura Ghat, Mahuli Ghat, and Keshopur Ghat) of the River Ganga during 2022-2025. The fish were caught using local fishing gear and transported to the laboratory in aerated containers. The fish were examined for helminth parasites.

Parameters of Population Dynamics

The population dynamics of fish infection refers to the study of how the prevalence, intensity, and distribution of diseases and parasites in a fish population change over time and space.

Prevalence (P%): The prevalence of infection in fish refers to the proportion of a fish population that is currently infected with a disease or pathogen at a specific point in time..[3]

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$$\text{Prevalence \%} = \frac{\text{No. of infected fish} \times 100}{\text{No. of fish examined}}$$

Mean abundance (MA): Parasite abundance is defined as the number of individuals of a given parasite in a single host and can vary from zero to infinity.

$$\text{Mean abundance (unit)} = \frac{\text{No. of parasites}}{\text{No. of fish examined}}$$

Mean intensity (**MI**): The mean intensity of infection in fish is the average number of parasites found in infected fish within a sample population.

$$\text{Mean intensity (unit)} = \frac{\text{Average no. of parasites}}{\text{No. of infected fish}}$$

Parasite Frequency Index (PFI): The Parasite Frequency Index (PFI) is a quantitative measure used in parasitology to express a parasite's survival in a host.

Parasite Frequency Index (PFI) =

$$\frac{\text{Number of individuals of a particular parasite}}{\text{Total number of all parasites recovered from all fish}} \times 100$$

The parasite frequency index was classified into rare (0.1-9.9%), occasional (10-29.9%), common (30-69.9%) and abundant (70-100%)

The data were analyzed using Excel and AtoZmath.com software to determine prevalence, mean intensity, abundance and index of infection of helminth parasites in *Labeo rohita.*

3. RESULTS AND DISCUSSION

Variations in the number of helminth parasites: The yearly average distribution of helminth parasites is 38.82, ranging from 09 in December to 66.4 during July. On the other hand, genus-wise number of helminth parasites ranged from 4 *Camallanus* in December to 101.4 of *Haplocleidus* during July. The two-tailed F test concluded that the variation in months has a highly significant ($F = 49.98$, $p < 0.001$) effect on the number of parasites of *Labeo rohita*. The analysis further showed that the different parasites also have highly significant ($F=15.55$, $p<0.001$) effects on the number of parasites in this fish (Table 1). Descriptions are available on *Gyrodactylus elegans indicus* and *Dactylogyrus speciosus* from *Labeo rohita* in India [7, 8]. Farhaduzzaman et al. [9] observed ten parasite species in the Indian major carp *Labeo rohita* in Bangladesh's Rajshahi district. There were five helminth parasites (*Dactylogyrus vastator* Nybelim, 1924; *Gyrodactylus elegans* Nordman, 1832; *Camallanus ophiocephali* Nicoll, 1909; *Fellodistomum agnotum* Pearse, 1933; and *Eucreadium* sp).

Table 1: Average number of parasites selected from all collection sites during 2022-2025

Sl. No	Parameters	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
1.	***Haplocleidus***	24.2	37.5	56.2	62.4	73.6	87.6	101.4	93.4	85	74.4	27.6	15	**61.52**
2.	***Dactylogyrus***	19.4	26.6	42.0	48.2	56	65	81.4	71.8	64.8	57.2	21	11.4	**47.07**
3.	***Gyrodactylus***	14.2	18.8	27.8	36	40.6	51.4	64.2	59.2	57.8	43.6	15.4	8.0	**34.42**
4.	***Euceradium***	10	11.4	22.8	23	27	36.4	49.4	47.2	35.4	32.2	11	6.6	**26.03**
5.	***Camallanus***	6	7.8	17	16.6	20.6	25.4	35.8	36.4	27.4	25.6	6.2	4	**19.07**
	Average	**14.8**	**20.4**	**33.2**	**37.2**	**43.6**	**53.2**	**66.4**	**61.6**	**54.1**	**46.6**	**16.2**	**9**	**38.02**
Two-way ANOVA 49.98* (df=11 and 44) and 15.55*** (df=4 and 44)**														

Variations in the prevalence of helminth parasites: The yearly average prevalence of helminth parasites was 41.67 % ranging from 18.5% during winter to 61.0% during the monsoon. The chi-square test concluded that the variation in seasons has a highly significant (chi-square = 12.35, $p < 0.001$) effect on the prevalence of parasites in *Labeo rohita* (Table 2). Radwan et al. [10] calculated an 87.82 % prevalence of helminth parasites in *Clarias gariepinus* in Egypt. Tiwari et al. [11] calculated a prevalence of helminth parasites from 37.5% to 44% in freshwater fish in India. Therefore, the prevalence may

vary from 37% to 87.82% among different fish, which may depend on various factors.

Variations in the mean abundance of helminth parasites: The yearly average of the mean abundance of helminth parasites of 6.31 ranged from 2.52 during winter to 9.45 during the monsoon. The chi-square test inferred that the variation in the seasons has an insignificant (chi-square=2.28, $p > 0.05$) effect on the mean abundance of parasites of *Labeo rohita* (Table 2). Bhuiyan et al. [12] observed the maximum mean intensity (58.8) in September; the value in November was closer to the maximum value, while the minimum was recorded in July in Bangladesh. Tiwari et al. [11] calculated the abundance of helminth parasites to be 0.80 to 3.35 in freshwater fish of India. Therefore, the abundance may vary from 0.80% to 9.5% in different fish, which may depend on various factors.

Table 2: Seasonal variations on the Ecological aspects of helminth parasites infections on *Labeo rohita* during 2022-2025

Sl. No.	Season	Prevalence (%)	Mean abundance (MA)	Mean Intensity
1.	Summer (March to June)	45.5	6.96	15.30
2.	Monsoon (July to Oct)	61	9.44	15.49
3.	Winter (Nov to Feb)	18.5	2.52	13.59
	Average	**41.67**	**6.31**	**14.79**
	Chi-square value	12.35 ($p<0.001$)	2.28 ($p>0.05$)	0.075 ($p>0.05$)

Variations in the mean intensity of helminth parasites: The yearly average of the mean intensity of helminth parasites was 14.79, ranging from 13.30 during winter to 15.59 during summer. The chi-square test inferred that the variation in seasons has an insignificant (chi-square=0.075, $p > 0.05$) effect on the mean intensity of parasites in *Labeo rohita* (Table 2). Bhuiyan et al. [12] observed the highest abundance in November, and October and December occur closer to the highest value, while the lowest was in July. The values in June and August were closer to the lowest value in Bangladesh. Tiwari et al. [11] calculated the intensity of helminth parasites from 6.4% to 25.04% in freshwater fish in India. Therefore, the intensity may vary from 37% to 78.57% in different fish, which may depend on various factors.

Variations in the frequency index of helminth parasites: The yearly average frequency index of helminth parasites ranges from 9.51 of *Camallanus (rare)* to 33.03 of *Haplocleidus* (common). On the other hand, genus-wise frequency index of helminth parasites ranged from 7.95 for *Camallanus* in winter to 33.48 of *Haplocleidus* during summer. The two-tailed F test inferred that the variation in seasons has an insignificant ($F = 0.59$, $p > 0.05$) effect on the frequency index of parasites in *Labeo rohita*. The analysis further showed that the different parasites also have a highly significant ($F = 80.66$, $p<0.001$) effect on the frequency index of parasites in this fish (Table 3). The highest parasite infection index of 23.07 of *Dactylogyrus* in *Labeo rohita* was calculated during winter (November and February). Ghosh et al. [13] also observed the highest infestation of *Dactylogyrus sp.* in Indian Major Carp (*Catla catla*) during winter (December and February), which is similar to this study. Ogawa [14] reported a higher prevalence of *Bivagina tai* (a microcotylid, monogenean) in October to January.

Table 3: Seasonal variations on the parasite frequency index on *Labeo rohita* during 2022-2025

Sl. No.	Season	***Haplocleidus***	***Dactylogyrus***	***Gyrodactylus***	***Eucreadium***	***Camallanus***
1.	Summer (Mar to June)	33.48 (Common)	25.27 (Occasional)	18.64 (Occasional)	13.07 (Occasional)	9.53 (Rare)
2.	Monsoon (July to Oct)	31.24 (Common)	24.28 (Occasional)	12.61 (Occasional)	14.48 (Occasional)	11.04 (Occasional)
3.	Winter (Nov to Feb)	34.37 (Common)	26.07 (Occasional)	15.76 (Occasional)	12.91 (Occasional)	7.95 (Rare)
	Average	**33.03** (Common)	**25.21** (Occasional)	**15.67** (Occasional)	**13.49** (Occasional)	**9.51** (Rare)
	Chi-square value	0.09 ($p>0.05$)	0.04 ($p>0.05$)	0.001 ($p>0.05$)	0.08 ($p>0.05$)	0.24 ($p>0.05$)
Two-way ANOVA 0.59^{NS} (df=2 and 8) and 80.66* (df=4 and 8)**						

4. CONCLUSIONS

Based on the findings acquired in the current study, the occurrence of maximal infection/infestation in the rainy season and minimum in the winter can be explained by the fact that between July and August, the food availability was greater in the winter season, as was the temperature. As a result, the fish's mobility increased, and the muddy situation created a more contaminated environment in which the fish may become infected

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