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ON THE PREVALENCE OF ECTOPARASITES IN RUI (*LABEO ROHITA*) IN GREATER MYMENSINGH REGION, BANGLADESH

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ABSTRACT: The study investigated the prevalence of ectoparasites in Rui, *Labeo rohita* collected from greater Mymensingh, Bangladesh, between July 2022 and June 2023. A total of 960 samples were randomly collected to identify the ectoparasites using a microscope, and in the second phase, direct smears were prepared from probable lesions. In this study, a total of ten different ectoparasites were identified, including myxozoans (*Myxobolus* sp., *Thelohanellus* sp., and *Henneguya* sp.); ciliophorans (*Trichodina* sp., *Tripertiella* sp., and *Ichthyophthirius multifilis*); monogeneans (*Dactylogyrus* sp. and *Gyrodactylus* sp.); and crustaceans (*Ergasilus* sp., *Argulus* sp., and *Lernea* sp.). Myxozoans and ciliophorans were more prevalent among these parasites, followed by the monogeneans and crustacean parasites. The highest ectoparasitic prevalence (35.04%) was recorded from January to February, while the lowest (6.67%) was from July to August. This study indicates that winter was more favorable for the outbreaking of these ectoparasites in *L. rohita* cultured using carp polyculture system earthen ponds in greater Mymensingh, Bangladesh. Carp polyculture farmers are suggested to take preventive measures like avoiding the deterioration of water quality, high stocking density, and application of lime and common salt in inhibiting the outbreak of these ectoparasites for better production, economic return, and sustainability of Indian major carp culture in Bangladesh.

***Key words*:** Aquaculture, carp polyculture, fish parasites, Indian major carp, *Labeo rohita.*

INTRODUCTION

The Indian Major Carps (IMC) are the natural inhabitants of the perennial river network of Bangladesh, India and Pakistan and enjoy a wide distribution. The most significant species of Indian major carp utilized in carp polyculture systems is Rui (*Labeo rohita),* but they also pose a risk of diseases. The occurrence of emerging fish pathogens and their relevant diseases have often

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outbroken due to the intensification of aquaculture along with high stocking densities as well as excessive application of different antimicrobial drugs (Mehdizadeh-Mood *et al.* 2011 and Habib *et al.* 2019). Furthermore, the uncontrolled transboundary movement of aquatic animals, and unregulated ornamental live fish trade without proper biosecurity measures are facilitated in spreading or outbreaking fish diseases across the borders towards fish trade sites include fish farms (Giri, 2018 and Subasinghe *et al.* 2023). Additionally, various fish diseases especially parasitic diseases do pose a significant threat to the health and productivity of carp fish farming systems in Bangladesh (Garza *et al.* 2019 and Monir *et al.* 2015).

Parasites found in aquatic organisms are widespread and integral components of ecosystems, often influenced by various biotic and abiotic factors in their environment (Lacerda *et al.* 2017 and Omeji *et al.* 2022). Fishes are susceptible to the highest rates of parasitic infestation among all vertebrates because their aquatic environment provides ideal conditions for parasites to spread, reproduce, and complete their life cycles (Emily *et al.* 2018). Fish pathogens include parasitic diseases have involved a significant impediment in reducing immunity and overall health which further resulting inadequate fish growth, mortality and economic losses (Omeji *et al.* 2022). Moreover, the slow growth rates of fishes owing to diseases have reduced feed conversion efficiency, lower affordability with low price, and like have rejected by consumers (Hamouda *et al.* 2018). Additionally, they pose zoonotic risks to both animals and humans who consumed fish. Also, fish pathogen and their diseases do bring many serious problems include depleting nutrients (Hassan *et al.* 2010), disrupting behaviour and biological mechanisms (Lacerda *et al.* 2017), and acting as stressors that reduce immunity and welfare of fishes. However, these have resulted the fishes more prone to various pathogenic infections and subsequently diseases outbreak occurs which further leading to increase illness and mortality (Nmor *et al.* 2004).

Parasites are often affected host and impacted to its physical, mechanical and chemical properties (Hoffman, 2019). In Bangladesh, ectoparasitic protozoans, fish argulus, and anchor worms are among the crucial pathogens that significantly affect yields in carp hatcheries, seed production, and farming (Nematollahi *et al.* 2013). The highest fish mortality in carp nursery ponds has been attributed to parasitic infestations such as *Trichodina* sp. and *Myxobolus* sp. (Rahman *et al.* 2016). Whereas, the infection of *Gyrodactylus*, *Dactylogyrus*, and *Argulus* are being disturbed the respiratory function of fish skin and gills, resulting in fish appearing dull, weak, irregular swimming with erratic movements to the water surfaces which may eventually lead to exhaustion and death (Faruk, 2018). Parasites can cause mechanical injuries such as skin disorders, necrotized gills, and ulcers, depending on their species and abundance (Echi *et al.* 2009). Besides, Dogiel (1961) reported 15 influencing factors of parasitic infestation among fishes which directly impact health. These factors consisted of fish age group, feed quality, stocking density and fish population abundances, the presence of diverse pathogens and parasites among various fishes as well as seasonal environmental changes. Sumuduni *et al.* (2016) noted that the culture water body and its water quality properties influence in occurring parasitic community and diseases outbreaks. In this standpoint, Dash *et al.* (2015) reported that the prevalence of parasitic disease was more common during the winter when compared to the other seasons.

Parasitic infections, particularly those caused by ectoparasites in carp aquaculture, have emerged as a significant threat to the health and productivity of Indian major carps, especially Rui, *L. rohita*. As aquaculture practices become more intensive, the increased risk of disease outbreaks has a direct impact on fish production, economic returns, and food security in Asian region include Bangladesh. Moreover, a thorough understanding of the relationship between parasite prevalence and environmental factors is essential for developing effective disease control strategies and promoting sustainable aquaculture practices. Therefore, this study undertaken to assessed the prevalence of ectoparasites in *L. rohita* production in earthen pond system of greater Mymensingh, Bangladesh.

MATERIAL AND METHODS

The present study was undertaken in Mymensingh, Bangladesh, between July 2022 and June 2023 (Table 1). The samples of *L. rohita* were collected from carp polyculture ponds with the assistance of local farmers every month throughout the study period. The collected fishes were then transported to the Fish Disease and Health Management Laboratory at Bangladesh Fisheries Research Institute (BFRI), Mymensingh, and kept in small aquariums for further observation. Approximately 960 fish were examined for ectoparasite infections. The samples of fish body smears, fins and gills were prepared using contamination-free slides with a 0.5% NaCl solution; these were then air-dried. Each mount was then scrutinized for the identification of parasites using a compound light microscope (Olympus, Tokyo, Japan) at 40–100 X magnification.

In brief, Lom and Vavra (1963) described methodology was performed to detect myxozoan spores in which Indian ink was used. Additionally, air-dried smears were stained with Giemsa for permanent preparation. The ciliophoran parasites were detected with method of Klein (1958), where silver impregnation was done. The monogenean parasitic enumerations were performed according to the methodology of Yamaguti (1963). The stain of cotton blue permanent preparation done to determine the crustacean parasites. These parasites were identified according to the reference materials (Das and Das 1997; Mishra *et al.* 2007; and Sumuduni *et al.* 2016).

There were six categorized group of months: July to August, September to October, November to December, January to February, March to April, and May to June. Prevalence rates were estimated for each recovered genus of the parasite, and the prevalence was determined by dividing the number of infested fish by the total number of observed fish, then multiplying by one hundred. The four major water quality parameters such as water temperature, pH, dissolved oxygen, and hardness were measured every month. Water temperature, pH, and DO of the collected pond water samples were measured by a thermometer, pH meter, and DO meter, respectively, where titration methods were used for the measurement of hardness.

RESULTS AND DISCUSSION

The prevalence of ectoparasite species in *L. rohita* over the 12 months period presented in the Table 2. Infected fish exhibited signs of irritation and sluggishness, with most showing reddish coloration and white spots across their bodies. In this study, three myxozoan parasites genus namely *Myxobolus* sp., *Thelohanellus* sp. and *Henneguya* sp. were identified. Among these, *Myxobolus* infections were predominantly recorded from November to February, while *Thelohanellus* sp. was most prevalent in January and February. In contrast, *Henneguya* infections remained consistently low throughout the year (Table 2). Biosci et al. (2019) also reported ectoparasites as a common problem in fish reared in ponds, tanks, and aquariums. Similarly, Nematollahi *et al.* (2013) documented comparable findings of these ectoparasites in cultivated Bighead carp (*Hypophthalmichthys nobilis*) in Mashhad, Iran.

In the present investigation, there were three ciliophoran parasites, such as *Trichodina* sp., *Tripartiella* sp., and *Ichthyophthirius multifiliis*, there were detected consistently throughout the year. Among them, *Ichthyophthirius* infections were comparatively less prevalent. The highest prevalence of *Trichodina* sp. was observed during January and February. These results concur with Omeji *et al.* (2022), who reported the maximum peak of *Trichodina* infestations were between January and February and the minimum level were between July and August. Similarly, Habib *et al.* (2019) and Nematollahi *et al.* (2013) showed that *Trichodiniasis* persisted throughout the year, with the highest infection rates occurring in January and February. These previous observations are in corroborated with the current findings.

Moreover, Habib *et al.* (2019) documented that shallow ponds with stagnant water conditions promote the proliferation of ciliate parasites include *Trichodina*. Winaruddin and Eliawardani (2007) found that *Trichodina* sp. infected not only the gills but also the operculum, fins, and body scales of carp species. Furthermore, Mehdizadeh-Mood *et al.* (2011) reported that rainbow trout (*Oncorhynchus mykiss*) in Iran were infected by this ectoparasite. In addition, Rahman et al. (2016) observed that *Ichthyophthirius* sp. infections peaked between January and February, which supports the findings of the present study.

The current study reported a higher prevalence of *Gyrodactylus* and *Dactylogyrus* spp. from November to April, with a noticeable decrease in infestation levels from July to August. This observation is supported by the findings of Rahman et al. (2016), who recorded peak infestations of both *Gyrodactylus* sp. and *Dactylogyrus* sp. in fish. Among the two monogeneans, *Dactylogyrus* sp. exhibited a higher prevalence compared to *Gyrodactylus* sp., particularly between November and February.

Sumuduni et al. (2016) found that the reproduction of monogenean parasites was influenced by water quality parameters and primarily occurs on the host's body, with variations in their attachment methods being linked to both chemical and mechanical factors. In the present study, monogeneans were observed particularly on the gills and skin of the host *L. rohita*, consistent with their ectoparasitic nature. This finding was in agreement by Dash et al. (2015), who observed *Dactylogyrus* sp. attached to the gills and *Gyrodactylus* sp. aggregating in specific skin regions. The majority of parasites are discovered to choose a location where they are not exposed to the full force of the water circulation.

In the crustacean parasite group, *Argulus* sp., *Ergasilus* sp., and *Lernea* sp. were identified, whereas crustacean parasites were exclusively present from September to June, with no occurrences throughout the rest of the year. *Ergasilus* sp. exhibited a higher prevalence of fish infections compared to *Argulus* sp. and *Lernea* sp., respectively. During winter, when carp lose their appetite, they become stressed and are more susceptible to various diseases. In the current research, Rui was observed to be attacked by *Ergasilus* sp. and *Argulus* sp. at that time. The current observations were supported by previous studies (Dash *et al.* 2015; Sumuduni *et al.* 2016; and Habib *et al.* 2019), they reported *Argulus* sp. in different carps.

Table 1. Sampling sites and GPS coordinates in Mymensingh region

Sampling Area (Upazila)	District	GPS Coordinates (Latitude, Longitude)
Bhaluka	Mymensingh	24.2258° N, 90.3882° E
Trishal	Mymensingh	24.3949° N, 90.4033° E
Tarakanda	Mymensingh	24.9000° N, 90.3667° E
Mymensingh Sadar	Mymensingh	24.7564° N, 90.4065° E
Muktagacha	Mymensingh	24.7582° N, 90.2668° E

In this study, among all parasite groups, the highest prevalence was observed during January to February (35.04%), followed by November to December (23.58%), March to April (17.08%), and September to October (12.48%) (Table 3).

Table 2. Prevalence (%) of different ectoparasites in Rui, *L. rohita*

Months	Myxozoans	Prevalence (%)	Ciliophorans	Prevalence (%)	Monogeneans	Prevalence (%)	Crustacean	Prevalence (%)
Jul–Aug	*Myxobolus* sp.	30	*Trichodina* sp.	21	*Dactylogyrus* sp.	2	*Ergasilus* sp.	0
	Thelohanellus sp.	15	*Tripertiella* sp.	9	*Gyrodactylus* sp.	0	*Argulus* sp.	0
	Henneguya sp.	2	*Ichthyophthirius multifilis*	0			*Lernea* sp.	0
Sep–Oct	*Myxobolus* sp.	47	*Trichodina* sp.	28	*Dactylogyrus* sp.	11	*Ergasilus* sp.	2
	Thelohanellus sp.	24	*Tripertiella* sp.	13	*Gyrodactylus* sp.	2	*Argulus* sp.	7
	Henneguya sp.	4	*Ichthyophthirius multifilis*	2			*Lernea* sp.	3
Nov–Dec	*Myxobolus* sp.	53	*Trichodina* sp.	32	*Dactylogyrus* sp.	37	*Ergasilus* sp.	34
	Thelohanellus sp.	28	*Tripertiella* sp.	18	*Gyrodactylus* sp.	7	*Argulus* sp.	29
	Henneguya sp.	2	*Ichthyophthirius multifilis*	8			*Lernea* sp.	13
Jan–Feb	*Myxobolus* sp.	65	*Trichodina* sp.	58	*Dactylogyrus* sp.	49	*Ergasilus* sp.	54
	Thelohanellus sp.	42	*Tripertiella* sp.	32	*Gyrodactylus* sp.	12	*Argulus* sp.	32
	Henneguya sp.	3	*Ichthyophthirius multifilis*	26			*Lernea* sp.	17
Mar–Apr	*Myxobolus* sp.	32	*Trichodina* sp.	37	*Dactylogyrus* sp.	30	*Ergasilus* sp.	24
	Thelohanellus sp.	13	*Tripertiella* sp.	19	*Gyrodactylus* sp.	6	*Argulus* sp.	13
	Henneguya sp.	1	*Ichthyophthirius multifilis*	7			*Lernea* sp.	6
May–Jun	*Myxobolus* sp.	21	*Trichodina* sp.	26	*Dactylogyrus* sp.	20	*Ergasilus* sp.	12
	Thelohanellus sp.	9	*Tripertiella* sp.	14	*Gyrodactylus* sp.	3	*Argulus* sp.	4
	Henneguya sp.	1	*Ichthyophthirius multifilis*	2			*Lernea* sp.	0
Average		**21.78**		**19.56**		**14.92**		**13.90**

The mean (± SD) water temperature, pH, DO and hardness were 25±3.78 ºC, 7.40±0.59, 5.48±0.43 ppm and 123.87±5.88 ppm, respectively (Table 4). The monthly correlation between various water quality parameters and three parasitic groups i.e., ciliates, myxozoans, and monogeneans have presented in the figure 1 (A-D). The ectoparasitic prevalence has shown temperature sensitivity. It was found that ectoparasitic prevalence increased when water temperature and hardness decreased (Figure 1A & D), and optimum levels of dissolved oxygen (DO) and nearly neutral pH had a positive effect on the ectoparasitic prevalence in this study (Figure 1B & C).

Table 3. Monthly prevalence (%) of ectoparasites of Rui, *L. rohita*

Parasites	July– Aug	Sep– Oct	Nov – Dec	Jan–Feb	Mar–Apr	May–Jun
Myxozoans	15.67	25.00	27.67	36.67	15.33	10.33
Ciliophorans	10.00	14.33	19.33	38.67	21.00	14.00
Monogeneans	1.00	6.50	22.00	30.50	18.00	11.50
Crustaceans	0	4.00	25.33	34.33	14.00	5.33
Average prevalence	6.67	12.46	23.58	35.04	17.08	10.29

Table 4. Monthly fluctuations of water quality parameters in carp polyculture ponds

Months	Water quality parameters			
	Tempera ture (°C)	pH	Dissolved oxygen (ppm)	Total hardness (ppm)
Jul – Aug	28	6.7	5.6	130.6
Sept – Oct	26	7.6	5.9	127.9
Nov– Dec	23	7.4	6.1	117.3
Jan – Feb	19	6.6	4.8	114.5
Mar – Apr	25	7.9	5.3	125.7
May – Jun	31	8.2	5.2	127.2
Mean ± SD	25±3.78	7.40±0.59	5.48±0.43	123.87±5.88

Table 5. Correlation co-efficient among the temperature, dissolved oxygen, pH, total hardness, and the various group of ectoparasites such as mixozoans, ciliophorans, monogeneous and crustaceans

	Temperature	DO	pH	Hardne ss	Mixoz oans	Cilioph orans	Monoge neous	Crusta ceans
Temperature	1							
DO	0.359	1						
pH	-0.557	-0.533	1					
Total hardness	0.996**	0.297	-0.539	1				
Mixozoans	-0.917*	-0.474	0.815*	-0.904*	1			
Ciliophorans	-0.864*	-0.032	0.446	-0.860*	0.764	1		
Monogeneous	-0.802	0.204	0.371	-0.836*	0.668	0.908*	1	
Crustaceans	-0.890*	-0.020	0.529	-0.914*	0.791	0.903*	0.971**	1

**Correlation is significant at the 0.01 level (2-tailed); *Correlation is significant at the 0.05 level (2-tailed).

In this study, a positively correlation was found between total hardness and water temperature (r= 0.996**), while mixozoans (r= - 0.917*), ciliophorans (r= -0.864*) and crustaceans (r= -0.890*) were showed negative correlation with temperature. Similarly, mixozoans (r= -0.904*), ciliophorans (r=-0.860*), monogeneous (r= -0.836*) and crustaceans (r= -0.914*) were negatively corelated with total hardness. The significant positive correlation was shown between pH and mixozoans (r = 0.815*). Furthermore, ciliophorans found to have a positive correlation with monogeneous (r= 0.908*) and crustaceans (r= 0.903*). While, crustaceans had a positive correlation with monogeneous (r = 0.971**) (Table 5). In this study, most of the ectoparasitic infections were at their peak from

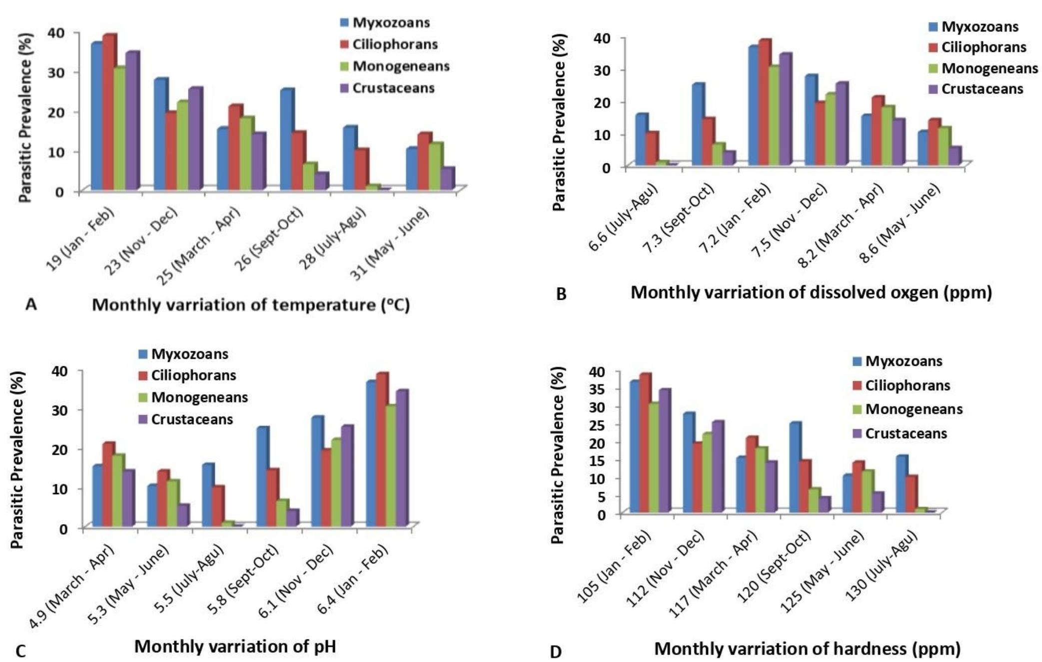

Figure 1. Correlation of parasitic prevalence (%) with different water quality parameters: A. Water temperature (C); B. Dissolved oxygen (ppm); C. pH, and D. Total hardness (ppm)

November to February, when water quality deteriorated due to decreased temperature and dissolved oxygen levels. The situation became worse in waters with low dissolved oxygen and high organic matter, as many of these parasites had simple and direct life cycles, enabling rapid multiplication in such conditions. Dash *et al.* (2015) and Omeji *et al.* (2022) support the present observations, indicating that reduced dissolved oxygen and deteriorating water quality during winter may be the probable reasons for the prevalence of these parasites. Moreover, Nematollahi *et al.* (2013) reported that most of the ectoparasites were more prevalent, particularly at low temperatures. This could be because fish are more vulnerable to parasite infestation in low temperatures, which was supported by Dash *et al.* (2015).

Additionally, moderate dissolved oxygen (DO) levels and nearly neutral pH favored parasite prevalence, with a positive correlation between pH and myxozoans (r = 0.815*), consistent with Rahman et al. (2016). Additionally, strong positive correlations among parasite groups such as ciliophorans with monogeneans (r = 0.908*) and crustaceans (r = 0.903*) suggest co-infection dynamics and shared environmental drivers (Noga, 2010 and Paperna, 1996). The high correlation between temperature and hardness (r = 0.996**) underscores the need for holistic water quality management to control parasitic infections and promote sustainable aquaculture. Rahman *et al.* (2016) also supports the proposition that parasite infection is seasonally dependent and predominantly disrupts the fish's ecology and physiology. However, outbreaks of ectoparasitic diseases are also influenced by the high stocking density of Rui in polyculture (Hossain *et al.* 2008 and Rahman *et al.* 2016). According to Habib *et al.* (2019), the probability of ectoparasite transmission between fish increases as stocking density rises, as does the availability of hosts for ectoparasitic infections. Consequently, the abundance of parasites populations and their ability to thrive on their hosts are greatly influenced by the quality of the water and different cultured systems.

CONCLUSIONS

The current investigation concludes that Rui is susceptible to various parasites, including *Myxobolus* sp., *Thelohanellus* sp., *Trichodina* sp., *Gyrodactylus* sp., *Dactylogyrus* sp., *Ergasilus* sp., *Argulus* sp., and *Lernaea* sp. These parasites are predominantly found on the skin, fins, and gills of the fish. Winter emerges to be the most vulnerable season for ectoparasitic occurrence and outbreak, which are likely due to deteriorating water quality and increased stress in the fish, which further facilitated parasite colonization. Effective control of ectoparasitic infections requires a comprehensive strategy in involving strict water quality management, appropriate stocking densities, regular health monitoring, and judicious use of antiparasitic treatments.

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