

Research Article

INFESTATION OF HELMINTH PARASITES AS BIOINDICATORS OF AQUATIC POLLUTION IN *TRICHOGASTER FASCIATA* (BLOCH AND SCHNEIDER, 1801) IN TAMLUK, PURBA MEDINIPUR, WEST BENGAL, INDIA

¹Antara Mahapatra and ^{2*}Biplab Mandal

¹ PG Department of Zoology, Tamralipta Mahavidyalaya, Tamluk 721636, Purba Medinipur, West Bengal.

²Department of Zoology, Vidyasagar University, Midnapore 721102, West Bengal.

Article History: Received 20th October 2025; Accepted 22nd December 2025; Published 1st January 2026

ABSTRACT

Trichogaster fasciata (Kholshes fish) is going to disappear day by day. Helminth parasites are the primary causes of diseases in this fish. Three infectious Helminth parasites are found that are Trematode, *Clinostomum complanatum*; Nematode, *Camallanus* sp.; and Acanthocephala, *Pallisentis ophiocephali*. Trematode is the most infectious and dangerous among the three. All invade in the specific sites, i.e. body cavity, stomach, rectum and intestine. Female Kholshes fishes are more susceptible than the males. Males are more resistant to the Helminth parasites. Abundance of diseases is highest in the summer season, followed by rainy and winter. It is due to the high temperature, pH and scarcity of dissolved oxygen in the water of the cultured fisheries. Severe Helminth infections in Kholshes fishes are one of the leading causes for their extinction in freshwater of the nature.

Keywords: *Trichogaster fasciata*, Helminth parasites, Prevalence, Seasonal variations, Aquatic Pollution.

INTRODUCTION

Trichogaster fasciata (banded gourami) is a common freshwater fish species in West Bengal. It is omnivorous and relatively sedentary, making it a suitable bioindicator species for site-specific monitoring. Global population is expected to reach 9.6 billion by 2050. The demand of animal protein is increasing every day. It is a very difficult problem to supply quality protein to the next generations. In this condition, fish culture plays a great role in supplying the required effective protein to the people. Fish culture is an important tool for the poverty alleviation of the people of developing countries. The fish contribute to around 17% of the global population's animal protein intake. Fishes are often called "Rich food for the poor people" as it supply the essential nourishment to the consumer with both macronutrients and micronutrients. Kholshes fishes, *Trichogaster fasciata* (Bloch and Schneider, 1801), are very tasty, palatable and nutritious and easily digestible. It is rich in protein (19%), vitamins and minerals (1.5%), and fat (3%). The amino acid content is very high. The medical doctors advised pregnant and milching mothers, sick and

ailing patients to take the diet of small fishes like Kholshes (Mookherjee *et al.*, 1946). Kholshes fishes are in the group of "Super Food" due to their high nutritional value. Kholshes fishes are available in India and in the Indian Sub-continent (Forese and Pauly, 2016). They live in the natural water reservoirs, tanks, paddy fields, canals, rivers, etc. (Rainboth, 1996). These fishes survive by consuming vegetable matter (85%) (Dasgupta, 2004). They are omnivorous. Algae and the decaying organic matter are the favourite food of this fish (Oldalin *et al.*, 2017). A full-grown Kholshes fish is 8-11 cm long, 2-4 cm broad and weighs 15-20 gm per fish. A healthy, full-grown mother Kholshes fish lays 5000-13000 eggs at a time (Mitra *et al.*, 2007). The laying period is from the month of April to September. This period is also their mating time; the best time is June-August (Das and Kalita, 2006 & Islam *et al.*, 2016; Prasad and Prasad, 1985). Kholshes fishes control the mosquitoes by eating the eggs, larvae, pupae, etc. People get relief from the invasion of Dengue, Malaria, Encephalitic diseases (Oldalin *et al.*, 2017) Kholshes fishes are herbivorous cum predator. It consumes the unused feeds

*Corresponding Author: Biplab Mandal, Department of Zoology, Vidyasagar University, Midnapore 721102, West Bengal, Email: bm16parasitology@gmail.com.

and other materials of the upper layer of the water of the fisheries and keeps the water clean (Chakraborty *et al.*, 1979; Sarma *et al.*, 2010). There are beautiful colour combinations on the body of the Kholshes. There are three varieties which are recognised as Red, Chana and Big Kholshes. The male fishes are brighter in colour and larger in size. Females are generally whitish green and shorter in figure (Islam *et al.*, 2016; Mitra *et al.*, 2007). Thirty thousand fish species have been reported in the world. Out of this 800 belong to the Ornamental fish, including the Kholshes. This fish has a good demand in the aquarium market due to its attractive, bright colour combination. This colourful fish is called the "Living Jewels" of the environment, which are exhibited in the aquarium of various parks, temples and corporate houses (Mitra *et al.*, 2007).

The health of freshwater ecosystems is increasingly threatened by anthropogenic activities such as industrial discharge, agricultural runoff, and urban wastewater contamination. These forms of pollution lead to alterations in the physicochemical properties of water, which directly affect aquatic organisms. Monitoring such ecosystems requires reliable biological indicators, and parasitological indicators have emerged as a valuable tool for such assessments. Fish parasites, especially helminths (trematodes, nematodes, and acanthocephalans), are highly

sensitive to environmental conditions and can provide insight into ecological disturbances. Their complex life cycles, which often involve multiple hosts including snails, crustaceans, and aquatic birds, make them particularly responsive to environmental fluctuations. Parasite diversity, prevalence, and intensity in fish hosts can thus reflect underlying environmental changes, especially pollution stress. The use of pesticides in the paddy fields and the notorious technique of catching the fish by the use of poison and dehydration of the water bodies, fully with the help of suction pump sets, might be the leading reasons for the abolition of small fishes like Kholshes from the water areas of India. This investigation contributes to the growing body of research supporting parasitological monitoring as a valuable tool in freshwater ecosystem health assessments.

MATERIALS AND METHODS

Study area

Kholshes (*T. fasciata*) were collected from the local fish market with the help of local fixed fishermen supplier of Tamruk, Purba Medinipur, West Bengal, from March 2021 to February 2022 and studied meticulously in the PG laboratory, Department of Zoology, Tamralipta Mahavidyalaya, Tamruk (22.301087°N, 87.926386° E) in an alive condition.

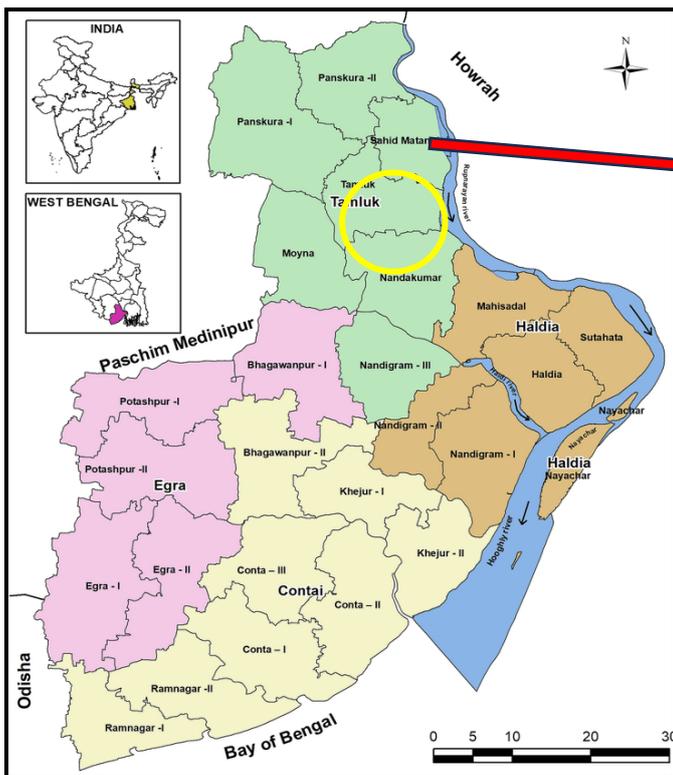


Figure 1. Map of Study area.

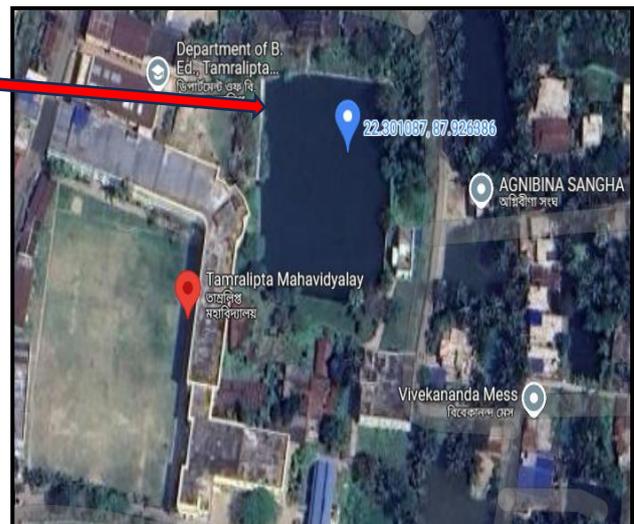


Figure 2. Satellite image of study area (22.301087°N, 87.926386° E).

Collection of fish with water samples

Water Samples along with the Kholshes fish were collected during pre-monsoon, monsoon, and post-monsoon from the pond for analysis of water temperatures as per seasons. The Konvio NEER digital water analysis kit has measured water temperatures. Collected Kholshes fishes were

thoroughly examined to study the parasitic abundance and prevalence of infestation in relation to length, breadth, sex, and season. This examination was conducted individually in the PG Laboratory, Department of Zoology, Tamralipta Mahavidyalaya, Tamluk.



Figure 3. Water Sample collection pond.



Figure 4. Length measurement of *T. fasciata*.

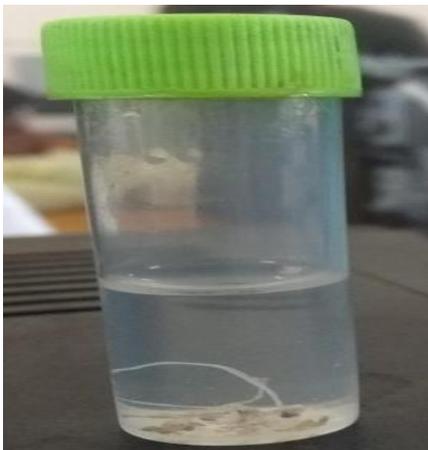


Figure 5. Fixed Parasites



Figure 6. *Pallisentis ophiocephali*



Figure 7. *Camallanus sp.*

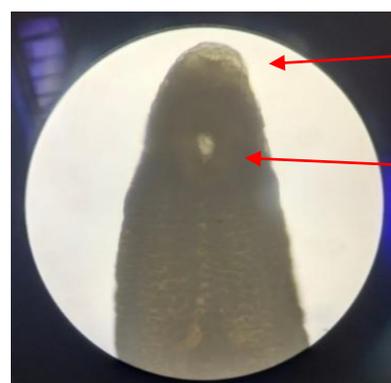


Figure 8. Microscopic view of collected Trematode (*Clinostomum complanatum*)

Dissection of fishes

Kholshe fishes were dissected along the mid-ventral line by a fine, sharp knife and scissors. The gut was carefully isolated with the help of forceps and a needle, and kept in the normal saline (0.9%) solution.

Preservation of Parasites

The active living parasites were noticed and collected mainly from the intestine and cavity of the body by using forceps and a needle were placed in normal saline water (0.9%). The collected specimen parasites were fixed in AFA (Alcohol 50%: Formalin: Acetic acid (100:6:2.5), stained with acetocarmine, dehydrated in ascending grades of ethanol, cleared in Xylene, and then mounted in DPX.

Microscopic study

Fixed parasites in the slides were studied thoroughly under the microscope, Magnus MSZ-Bi. The specimen parasites were identified by following the literature of Yamaguti, S. Vol. III (1961), Gibson *et al.*, 2002, Bhattacharya, 2007 and Naidu, 2012.

Data analysis

The prevalence and intensity of the parasites were estimated by the following the formula suggested by Margulis *et al.*, 1982. Statistical analyses like Pearson's correlation coefficient (r) and p-value were performed by using the software MS Excel 2021. The data were presented as mean \pm standard error (SE), and the P-value <0.05 was considered statistically significant.

RESULT AND DISCUSSION

Results in Table 1 demonstrate that the female Kholshe fishes (*T. fasciata*) are more susceptible (80%) to the Helminth parasites than the males (53.33%), where the intensity of infection is 5.06 in females and 3.06 in males. The 24 female Kholshe fishes were infected among the 30 fishes, where the collected worms were 121. But in the case of males, only 16 Kholshe fishes were infected out of 30. A total of 40 fishes were diseased out of 60. It means 69.99 % of Kholshe fishes were infected by the parasites, which were collected from the local pond at Tamruk. In the case of female fishes, the abundance ratio is 4.03, whereas in males it is 1.93. The analysis of the results demonstrated that females are more susceptible to the Helminth parasites than the males. Fish parasite frequency index (FPFI) is also abundant in female fishes (100.04%) as compared to the male fishes (84.55%).

Table 1. Study on the intensity of infection of Helminth Parasites of *T. fasciata* in relation to sex.

Sex	No. of fish examined	No. of fish infected	No. of Parasites collected	Prevalence (%)	Intensity (\pm)	Abundance	FPFI (%)
Male	30	16	58	53.33	3.06	1.93	84.55
Female	30	24	121	80.00	5.06	4.03	100.04

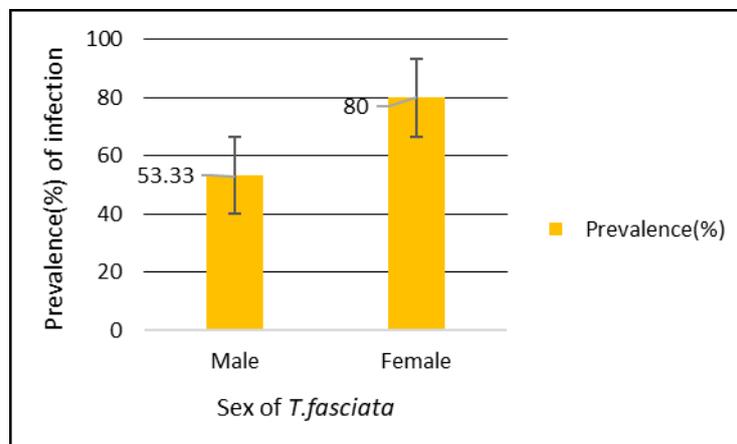


Figure 9. Intensity of Helminth Parasites infection in *T. fasciata* as per sex.

Table 2. Organ-wise detection of Helminth parasites in *T. fasciata*.

Helminth Groups	Name of the Parasites	Location	Examined Fishes	Infected Fishes	No. of worms collected	Intensity (±)	Prevalence (%)	Abundance
Trematode	<i>Clinostomum complanatum</i>	Body cavity		44	171	3.88	62.85	2.44
Nematode	<i>Camallanus sp.</i>	Stomach, Intestine, Rectum.	70	12	28	2.33	17.14	0.40
Acanthocephala	<i>Pallisentis ophiocephali</i>	Intestine		7	13	1.85	10.00	0.18

The results in Table 2 showed that the Trematode Helminth (*Clinostomum complanatum*) is the highest (62.85 %) infectious, followed by the Nematode (*Camallanus sp.*), which is 17.14 % and Acanthocephala (*Pallisentis ophiocephali*), which is only 10 %. 212 total of pathogens were collected from 63 infected out of 70 Kholshes fishes. In the case of Trematode (*C. complanatum*), 171 pathogens were collected from the 44 infected Kholshes fishes. But in Nematode (*Camallanus sp.*), it was only 28 and from 12 infected fishes. In the case of Acanthocephala (*Pallisentis ophiocephali*), 13 worms were found in 7 infected fishes. The results themselves revealed that Trematode is the

highest infectious among the three. The striking site of the *C. complanatum* is the body cavity of the Kholshes fish, whereas *Pallisentis ophiocephali* prefer to attack the intestine of the fish. But *Camallanus sp.* prefer to invade the body parts of the stomach, intestine and rectum of the digestive system of Kholshes fishes. Every pathogen chooses different favourable invasion sites in the host's body organs. There is a site specificity of the pathogens in the host body, as they choose the invading locations of the digestive system of the Kholshes fishes which are different in every parasites.

Table 3. Effects of seasonal variation on the intensity of infection of Helminth parasites in *T. fasciata*.

Seasons	No. of fishes examined	No. of fish infected	No. of Worms collected	Prevalence (%)	Intensity (±)	Abundance
Pre-monsoon (Summer)	25	24	117	96	4.87	4.68
Monsoon (Rainy)	25	22	59	88	2.68	2.36
Post-Monsoon (Winter)	25	16	23	64	1.43	0.92

Results in Table 3 revealed that the prevalence of the Helminth parasites is the maximum (96%) in the summer season, followed by the Rainy (88%) and Winter (64%). The reason is owing to the temperature and aquatic pollution in the fishery, which is much more in summer, followed by rainy and winter. The other reason might be due to the depth of the water in the fisheries. Depth of the water is the lowest in the summer season, which is one of the main reasons for aquatic pollution in the water bodies

where the Kholshes fishes live. High temperature of the summer is the most favourable condition for the multiplication of the pathogens of the fishes. Due to the low depth of the water level in the fisheries, high temperature, turbidity of the clay particles, and inorganic materials, blue-green algae, brown-green algae etc. enhances the aquatic pollution in the water. As a result, dissolved oxygen decreases, which causes the fatal death of the fishes in the summer season.

Table 4. Effects of the Temperature of water on the intensity of infection of Helminth parasites in *T. fasciata*.

Seasons	Optimum range	Temperature (°C) of the examined water	Prevalence (%)	r value	Extent of correlation	p value	Significance
Pre-monsoon (Summer)	10-30°C (Pre-monsoon)	31.03±2.01	96.00	0.9988	Positively correlated	0.0060 (P ≤ 0.05)	Significant
Monsoon (Rainy)	25-30 °C (Monsoon)	27.70±1.11	88.00				
Post-Monsoon (Winter)	22-28 °C (Post-monsoon)	19.71±1.94	64.00				

The positive r value indicated a proportional relationship between seasons and prevalence. As the season progresses from summer to winter, the parasitic load decreases due to the low temperature in the pond water. The value of P is 0.0060, which is less than the degree of freedom, α (0.05). Where $P \leq 0.05$, the correlation is statistically significant (Table 4).

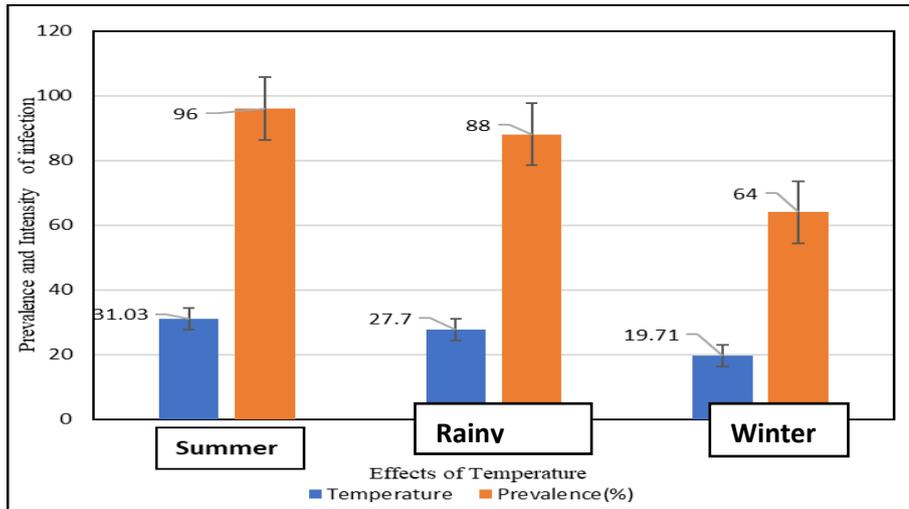


Figure 10. Graphical representation of the Prevalence of Helminth parasites in *T. fasciata* according to Temperature.

Table 5. Study on the effects of pH of the pond water on the intensity of infection of Helminth parasites in *T. fasciata*.

Seasons	Optimum pH range	pH of the examined water	Prevalence (%)	r value	Extent of correlation	p value	Significance
Pre-monsoon (Summer)		7.99±0.16	96.00				
Monsoon (Rainy)	6.5-8.5	7.54±0.09	88.00	0.9028	Positively correlated	0.0077 (P ≤ 0.05)	Significant
Post-Monsoon (Winter)		7.29±0.18	64.00				

The positive r value indicated a proportional relationship between seasons and prevalence. As the season progresses from summer to winter, the parasitic load decreases due to the low pH in pond water. The value of P is 0.0077, which is less than the degree of freedom, α (0.05). Where $P \leq 0.05$, the correlation is statistically significant (Table 5).

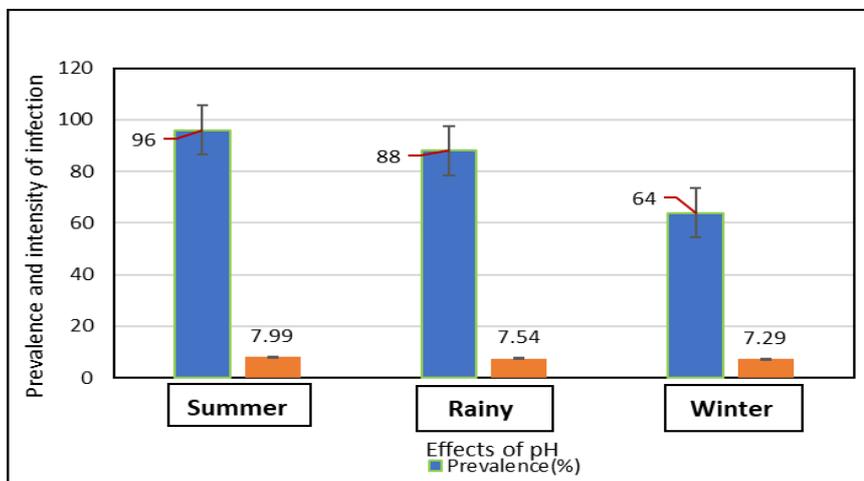


Figure 11. Graphical representation of the Prevalence of Helminth parasites in *T. fasciata* according to the pH.

Table 6. Study on the effects of Dissolved oxygen on the intensity of infection of Helminth parasites in *T. fasciata*.

Seasons	Optimum dissolved oxygen range	Dissolved oxygen	Prevalence (%)	r value	Extent of correlation	p value	Significance
Pre-monsoon (Summer)	5-10	4.99±0.32	96.00	-0.8237	Negatively correlated	0.0091 (P ≤ 0.05)	Significant
Monsoon (Rainy)		7.49±0.43	88.00				
Post-Monsoon (Winter)		8.16±0.37	64.00				

The negative r value indicated an inverse relationship between dissolved oxygen and prevalence. As the dissolved oxygen value is less than 5 in summer, the parasitic load increases in the pond water. It is observed from the experiment that when the value of the dissolved oxygen is in the suitable range, the parasitic load decreases gradually. The value of P is 0.0091, which is less than the degree of freedom, α (0.05). Where $P \leq 0.05$, the correlation is statistically significant (Table 6).

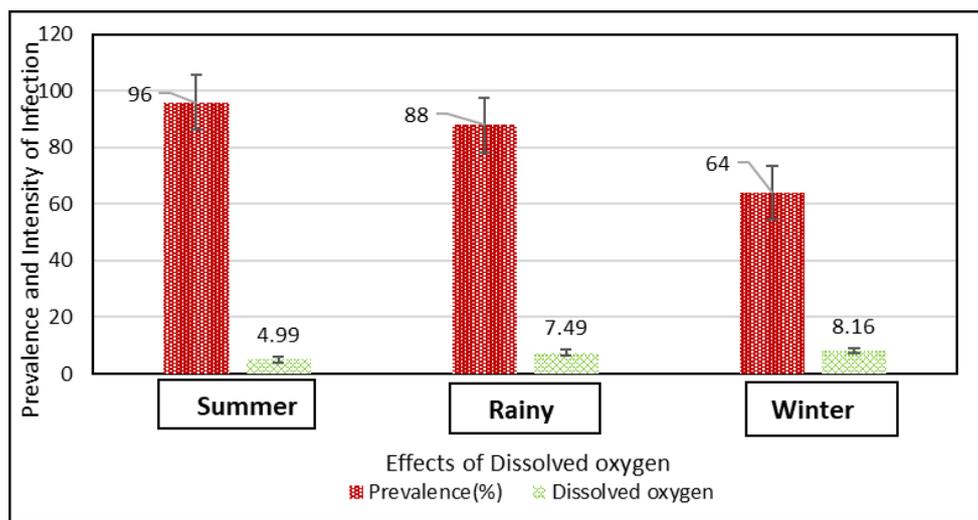


Figure 12. Graphical representation of the Prevalence of Helminth parasites in *T. fasciata* according to Dissolved oxygen.

212 Helminth pathogens are detected in the 63 infected Kholshes out of 70, which are collected from the local fish supplier of Tamluk, West Bengal, which are infected with 90%. Most of the Kholshes are infected with Helminth pathogens, which are very infectious to the host. Trematode Helminth parasite, *C. complanatum*, is the most dangerous to the Kholshes among the three. Kholshes are invaded in a particular site of the organ of the body parts of the host which they prefer. Trematode, *C. complanatum*, chooses to attack in the organ of the body cavity of the digestive system of the Kholshes fishes, whereas the Acanthocephala, *Pallisentis ophiocephali*, prefer to invade the intestine organ of the Kholshes fishes (Fielding *et al.*, 2003; Lyndon & Kennedy, 2001; Taraschewski, 2000,2006). But the Nematode (*Camallanus sp.*) chooses to invade the three separate locations, likewise the stomach, intestine and rectum (Dezfuli *et al.*, 2002,2003; Crompton & Joyner, 1980; Lane & Morris,2000; Jhansilakshmi & Madhabi,1997; Levsen, 2001; Stromberg & Crites, 1974,1975). The intensity of infection of the Helminth parasites is maximum in the summer season and least in the winter season (Khanum and

Parveen, 1997). Causes are due to the higher temperature, pH, and lower dissolved oxygen levels of the water where fishes are grown. Water depth of the fisheries is the lowest in the summer season. As a result, the temperature and the aquatic pollution are highest in the summer (Landsberg *et al.*, 1998) along with different algae, weeds, zooplankton, phytoplankton which exhaust the dissolved oxygen in the water of the fisheries. Pollutant factors of the water of the tested tank, such as pH, dissolved oxygen, temperature, etc. are changed as per the temperature of the season. The available data from this experiment revealed the aquatic pollution is the highest in the summer followed by rainy and winter. These pollutants play a great role in the pathogenic effects of Helminth parasites. There is a direct correlation between the aquatic pollution and infectivity of the pathogens. Severe pathogenicity of these pathogens causes the death of the fishes. These factors are one of the vital reasons for the higher infection rate in summer (Austin,1998; Arizo *et al.*,2022). These factors are also one of the main causes for the extinction of the Kholshes fishes in nature. The reasons are that fish with a large length and more weight tend to carry more parasites due to increased

surface area, longer lifespan, more frequent feeding and high metabolic rate. Infection by the Helminth parasites is the most severe in the summer due to the aquatic pollution, temperature, pH and scarcity of dissolved oxygen. Infectious Helminth pathogens to this fish is one of the main causes for the diminishing of the Kholshes fishes of this planet. The findings demonstrate a strong association between helminth parasite load and water pollution. Polluted waters promote intermediate host proliferation (e.g., snails), thus facilitating the parasite life cycle. Helminth parasites in *T. fasciata* is the mirror the pollution gradient, indicating their role as reliable bioindicators.

CONCLUSION

Kholshes fishes are vanishing day by day. It is revealed that the diseases are one of the main casualties for their extinction in nature. Helminth parasites are the main culprits. Trematode Helminth parasites, *Clinostomum complanatum*, are the most notorious among the three. Trematode (*Clinostomum complanatum*) likes to attack in the fixed organ, body cavity, whereas Acanthocephala (*Pallisentis ophiocephali*) prefers the intestine, and Nematode (*Camallanus sp.*) chooses the stomach, intestine and rectum respectively of the digestive system of the Kholshes fishes. Female Kholshes fishes are more susceptible than the males. Males are more resistant to the Helminth parasites. Kholshes fishes are the highest susceptible to the Helminth pathogens in summer, followed by the rainy and winter seasons for the aquatic pollution in the water of the cultured fisheries. This study confirms that helminth parasite infestation in *Trichogaster fasciata* correlates strongly with the degree of aquatic pollution in freshwater bodies of West Bengal. The parasitological parameters such as prevalence, mean intensity, and species richness increased significantly with the worsening water quality. These findings validate the hypothesis that helminth parasites can serve as sensitive and practical bioindicators for aquatic ecosystem health. The application of parasitological indices offers a non-invasive, ecological approach to the water quality monitoring. Seasonal and site-wise variations in parasite loads also emphasize the dynamic relationship between environmental stressors and host-parasite interactions. This work demonstrates its potential as a sentinel species in freshwater ecological monitoring.

ACKNOWLEDGMENT

Authors are highly thankful to the Principal, Tamralipta Mahaviyalaya, Tamluk, Purba Medinipur, for providing laboratory facilities. Authors are also thankful to the Parasitology laboratory, Department of Zoology, Vidyasagar University, Midnapore, for the continuous support to conduct this research work.

CONFLICT OF INTERESTS

The authors declare no conflict of interest

ETHICS APPROVAL

Not applicable

FUNDING

This study received no specific funding from public, commercial, or not-for-profit funding agencies.

AI TOOL DECLARATION

The authors declare that no AI and related tools are used to write the scientific content of this manuscript.

DATA AVAILABILITY

Data will be available on request

REFERENCES

- Arizo, J., Tasadac, H. S., & Nighat, U. N. (2022). Impact of aquatic pollution on fish fauna. In *Bacterial fish diseases* (Chap. V, pp. 103–112). Academic publisher.
- Austin, B. (1998). The effects of pollution on fish health. *Journal of Applied Microbiology*, 85(Suppl. 1), 234S–242S. <https://doi.org/10.1111/j.1365-2672.1998.tb05300.x>
- Bhattacharya, S. B. (2007). *Handbook on Indian Acanthocephala*. Kolkata, India: Zoological Survey of India.
- Chakraborty, R. D., Singh, S. B., & Rao, N. G. S. (1979). The evolution of the technique of composite fish culture at CIFRI. In *Souvenir of CIFRI, Golden Jubilee Year of ICAR*. Barrackpore, India: Central Inland Fisheries Research Institute.
- Crompton, D. W. T., & Joyner, S. M. (1980). *Parasitic worms*. London, England: Wykeham Publications Ltd.
- Das, S. K., & Kalita, N. (2006). Seed production technology of ornamental gourami *Colisa fasciata* and *Colisa lalia* under captive conditions: An experience in Assam. *Indian Aquaculture Asia Magazine*, 11(4), 13–14, 32.
- Dasgupta, M. (2004). Relative length of the gut of some freshwater fishes of West Bengal in relation to food and feeding habits. *Indian Journal of Fisheries*, 51(3), 381–384.
- Dezfuli, B. S., Giari, L., Simoni, E., Bosi, G., & Manera, M. (2002). Histopathology, immunohistochemistry and ultrastructure of the intestine of *Leuciscus cephalus* naturally infected with *Pomphorhynchus laevis* (Acanthocephala). *Journal of Fish Diseases*, 25, 7–14.
- Dezfuli, B. S., Giari, L., Arrighi, S., Domenghini, C., & Bosi, G. (2003). Influence of enteric helminths on the distribution of intestinal endocrine cells in brown trout *Salmo trutta*. *Journal of Fish Diseases*, 26, 155–166.

- Fielding, N. J., MacNeil, C., Dick, J. T. A., Elwood, R. W., Riddell, G. E., & Dunn, A. M. (2003). Effects of the acanthocephalan parasite (*Echinorhynchus truttae*) on the feeding ecology of *Gammarus pulex*. *Journal of Fish Diseases*, 26(8), 423–426.
- Froese, R., & Pauly, D. (2016). *FishBase* [Worldwide web electronic publication]. Retrieved from <https://www.fishbase.org>.
- Gibson, D. I., Jones, A., & Bray, R. A. (2002). *Keys to the Trematoda* (Vol. 1). Wallingford, UK: CABI Publishing.
- Islam, M. S., Akter, S., Hasan, M. R., & Sheba, S. S. (2016). Some aspects of the biology of banded gourami *Trichogaster fasciata* in Jessore, Bangladesh. *International Journal of Biosciences*, 9(4), 72–80.
- Jhansilakshmbai, K., & Madhabi, R. (1997). *Euclinostomum heterostomum* (Rudolphi, 1809) (Trematoda): Life cycle, growth and development of the metacercaria and adult. *Systematic Parasitology*, 38, 51–64.
- Khanum, H., & Parveen, S. (1997). Distribution and seasonal prevalence of endoparasites in *Macrognathus aculeatus* and *Mastacembelus armatus*. *Bangladesh Journal of Zoology*, 25(1), 15–21.
- Landsberg, J. H., Blakesley, B. A., Reese, R. O., McRae, G., & Forstchen, P. R. (1998). Parasites of fish as indicators of environmental stress. *Environmental Monitoring and Assessment*, 51, 211–232.
- Lane, R. L., & Morris, J. E. (2000). *Biology, prevention and effects of common grubs (digenetic trematodes) in freshwater fish* (Technical Bulletin, pp. 115). Ames, IA: Iowa State University.
- Levsen, A. (2001). Transmission ecology and larval behaviour of *Camallanus cotti* under aquarium conditions. *Aquarium Sciences and Conservation*, 3, 315–325.
- Lyndon, A. R., & Kennedy, C. R. (2001). Colonisation and extinction in relation to competition and resource partitioning in acanthocephalans of freshwater fishes. *Folia Parasitologica*, 48, 37–46.
- Margolis, L., Esch, G. W., Holmes, J. C., Kuris, A. M., & Schad, G. A. (1982). The use of ecological terms in parasitology. *Journal of Parasitology*, 68(1), 131–133.
- Mitra, K., Suresh, V. R., Vinci, G. K., Mazumder, N. N., & Biswas, D. K. (2007). Biology and fishery of banded gourami *Colisa fasciata* in a floodplain wetland. *Asian Fisheries Science*, 20(4), 409–423.
- Mookherjee, H. K., Gupta, S. N. S., & Chaudhury, P. K. R. (1946). Food and its percentage composition of adult food fishes of Bengal. *Science and Culture*, 12, 247–249.
- Naidu, K. V. (2012). *Fauna of India and the adjacent countries: Acanthocephala*. Kolkata, India: Zoological Survey of India.
- Oldalin, K., Das, S. K., & Bhakta, D. (2017). Food and feeding biology of *Trichogaster fasciata* from a wetland of West Bengal. *Journal of the Inland Fisheries Society of India*, 49(2), 3–9.
- Prasad, M. S., & Prasad, P. (1985). Larval behaviour during growth and development of air-breathing habit in *Colisa fasciata*. *Indian Journal of Fisheries*, 32(2), 185–191.
- Rainboth, W. J. (1996). *Fishes of the Cambodian Mekong*. Rome, Italy: FAO.
- Sarma, K., Pal, A. K., Ayyappan, S., Das, T., Manush, S. M., Debnath, D., & Barua, K. (2010). Acclimatisation of *Anabas testudineus* to test temperatures influences thermal tolerance and oxygen consumption. *Fish Physiology and Biochemistry*, 36, 85–90.
- Stromberg, P. C., & Crites, J. L. (1974). Life cycle and development of *Camallanus oxycephalus*. *Journal of Parasitology*, 60, 117–124.
- Stromberg, P. C., & Crites, J. L. (1975). Population biology of *Camallanus oxycephalus* in white bass. *Journal of Parasitology*, 61, 123–132.
- Taraschewski, H. (2000). Host–parasite interactions in Acanthocephala: A morphological approach. *Advances in Parasitology*, 46, 1–179.
- Taraschewski, H. (2006). Hosts and parasites as aliens. *Journal of Helminthology*, 80, 99–128.
- Yamaguti, S. (1961). *Systema helminthum* (Vol. III). New York, NY: Interscience Publishers.

