



Prevalence of *Lernaea cyprinacea* Infections in Indian Major Carp at Fish Farms of Bihar, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Lernaea cyprinacea, commonly known as anchor worms, represents a significant parasitic threat to Indian Major Carp (IMC) species in the aquaculture system. *Lernaea* parasitizing is widely reported, affecting brood stock, fingerlings, and marketable-sized freshwater fish species globally. This study aims to comprehensively investigate *Lernaea* infections in ten fish farms across Bihar, India, focusing on the prevalence, intensity, water quality parameters, fish weight, and associated factors affecting the occurrence of this parasite. The research combines field surveys, laboratory analysis, and epidemiological assessments to provide a holistic understanding of the impact of *Lernaea* on

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the health and productivity of Indian major carp populations. The analysis revealed a positive correlation between host body weight and the intensity of *Lernaea cyprinacea* infestation. Larger fish were more susceptible to parasitic infections, highlighting a potential vulnerability associated with the size of the host. In conclusion, this study contributes valuable insights into the dynamics of *Lernaea cyprinacea* infections in IMC stocks, emphasizing the species-specific susceptibility and the influence of host body weight on parasitic infestations. The findings provide a foundation for informed aquaculture practices aimed at minimizing the prevalence and impact of *Lernaea*, thereby enhancing the overall health and productivity of fish farms in the region. In conclusion, current research confirms that *Labeo catla* and larger fish are very susceptible to *Lernaea cyprinacea* infection.

Keywords: *Lernaea*; parasite; prevalence; Indian Major Carp; infestation; physico-chemical parameters.

1. INTRODUCTION

“India is the second largest fish-producing country worldwide with 8% of global fish production. Aquaculture contributes more than 50% of annual production and employs more than 14 million people” [1]. “Indian aquaculture is diverse with species of fish farming systems practiced such as reservoirs, ponds, tanks, and cages. Diseases are considered major impediments to the development of aquaculture causing significant socio-economic impact in many of the fish-producing countries in Asia” [2]. “Parasitic infestations especially due to ectoparasitic crustacean copepods, isopods and segmented leeches (Annelida: Zylanicobdella) are of significant concern for health and productivity in aquaculture worldwide including India” [3,4,5]. “Among the various parasites the current research is about *Lernaea cyprinacea* which feed on the mucus (contains innate immune components), skin and blood of the host, causing mechanical injuries and erosions leading to increased susceptibility of fish to super-infections and death” [6,5,7].

“*Lernaea cyprinacea* parasite known as anchor worm was first reported from the Eurasian region, and it spread globally through fish introduced into various countries” [8,9,10]. “The optimal temperature range for *Lernaea* is 26-30°C. If temperatures fall below 20°C, juvenile *Lernaea* are unable to complete their development and at 14°C, females will not reproduce. Approximately 110 species of lernaeids (*Lernaea* and *Lernaea*-like parasites) have been described, but *Lernaea cyprinacea* (one of the more common species) is found worldwide. It is most common in cyprinids, including koi, common carp, goldfish, and other species of fish” [11,12].

“*Lernaea cyprinacea* is a cosmopolitan ectoparasite belonging to the copepod group, and does not have a specific host” [13,14]. “Generally, *L. cyprinacea* embeds its anchor into the host’s body to suck blood. In fish, the parasites usually penetrate the skin, fins, and eyes. The infested wound gets infected which is one of the main reasons this disease can invite so many other microbial diseases to get sick of the infected fish” [11]. “*Lernaea* caused major kills in broodfish in the hatchery. They have also been reported to infest amphibians” [11]. “*Lernaea* is usually associated with significant mortality in aquaculture, and the effect is quite severe, as fish death may occur in massive numbers. Hence identification and treatment strategy for such parasitic infestation is paramount with scientific and legal regulations. The parasite should be identified primarily based on the morphological features followed by the molecular characterization. Treatments by many compounds like organochlorines, organophosphates, carbamates, pyrethroids, and acylurea have been applied as insecticides or anti-parasiticides in aquaculture, agriculture, and animal husbandry” [15].

2. MATERIALS AND METHODS

2.1 Study Area and Sample Collection

In the present study, ten fish farms of major carp at Darbhanga and Madhubani district of Bihar were visited from May 2022 to July 2022. The intended information was collected about various aspects of fish farming by directly investigating the owners/managers of the fish farms. For examination, fish samples were collected using cast and drag nets and then weighed. A total 124 fish samples were collected, out of these 46 *Labeo catla*, 39 *Labeo rohita*, 39 *Cirrhinus mrigala* for potential *Lernaea cyprinacea*

infestation and prevalence. The parasites were identified based on Avenant-Oldewage and Robinson [16] and photographed for documentation. Prevalence of infection was calculated according to Bush et al. [17].

2.2 Physico-chemical Parameters

Different water quality parameters of fish ponds such as water temperature (°C), dissolved oxygen (mg L⁻¹), pH, TDS (mg L⁻¹), ammonia (mg L⁻¹), nitrite (mg L⁻¹), were recorded at daytime. Dissolved oxygen, pH, ammonia, nitrite parameters were measured by a water test kit (AQUASOL and API), while water temperature and Total Dissolved Solids (TDS) were recorded through a digital thermometer (TP3001) and TDS conductivity meter (AQUASOL) respectively.

2.3 Data Analysis and Interpretation

The obtained dataset was analyzed with the help of MS Excel 2010. Also, it used a semi-quantitative form, considering them as follows: + if the host had ≤ 4 parasites, ++ if the host had 5-9 parasites, and +++ if the host has ≥ 10 parasites to indicate the intensity of parasite in major carps.

3. RESULTS

A total of 124 samples of major carps (*Labeo catla*, *L. rohita*, *Cirrhinus mrigala*) were examined from ten fish farms, among which only 43 (34.67%) samples were observed with the *Lernaea* infestation. In this study, only one species of *Lernaea* i.e. *L. cyprinacea* was identified. *L. cyprinacea* showed severe physical damage to fish where they are attached. The parasites appeared as small worm-like protrusions and were found on various parts of the hosts' body surface (Fig.1 & 2). It seems to show a preference for a particular body area for attachment; but the most heavily infected locations were found on the gills, skin, eye, and

fins (Table 4). The highest *Lernaea* infestation was observed at the Anil Mukhiya Fish Farm (58.33%) and Love Mukhiya Fish Farm (53.84%) whereas the lowest were observed at the Rohit Yadav Fish Farm (18.18%) and Sanjay Singh Fish Farm (21.42%) (Table 2). Among the three fish species sampled during the study, the highest prevalence of *Lernaea* was observed on *L. catla* (41.30%) following *C. mrigala* (33.33%), and *L. rohita* (28.2%) (Table 3). The prevalence of parasites increased with an increase in the body weight of fish (Table 4) and temperature. The mean values of temperature (°C), PH, DO (mg L⁻¹), TDS (mg L⁻¹), ammonia (mg L⁻¹), and nitrite (mg L⁻¹) were 31.4, 7.44, 3.7, 289.90, 0.37, 0.07 respectively (Table 1).

4. DISCUSSION

In the current study investigated the *Lernaea* prevalence at different fish farms in Darbhanga and Madhubani District, Bihar. Researcher collected the relevant data from the farms such as water quality, overall pond status, *Lernaea* prevalence, etc. *L. cyprinacea* (Linnaeus, 1758), which primary causative agent of lernaeosis in Indian Major Carps and Chinese Carps [18]. It is more site and host-specific than other species [19].

The results of the present study showed that *Lernaea cyprinacea* has a higher prevalence in *L. catla* (41.30%) as compared to the other fishes (*L. rohita* and *C. mrigala*) present in the same ponds. The results were agreed with Tasawar et al. [20] who reported 96 infected *L. catla* fish samples (prevalence 80%) out of 120, and Bilal et al. [21] who reported 60 infected *L. catla* fish samples (prevalence 41.7%) out of 144. Apart from this Abbas et al. [22] reported the highest number of *Lernaea* (100) in *L. catla*, and Aslam et al. [23] showed more prevalence of Lernaied parasite in Indian Major Carp.

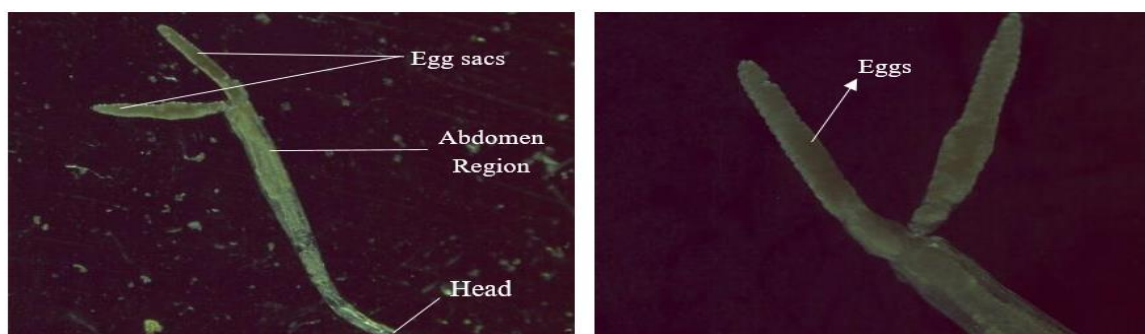


Fig. 1. A *Lernaea* specimen collected from an infected fish, and identified as *L. cyprinacea*. The arrow highlights the different parts of *Lernaea*

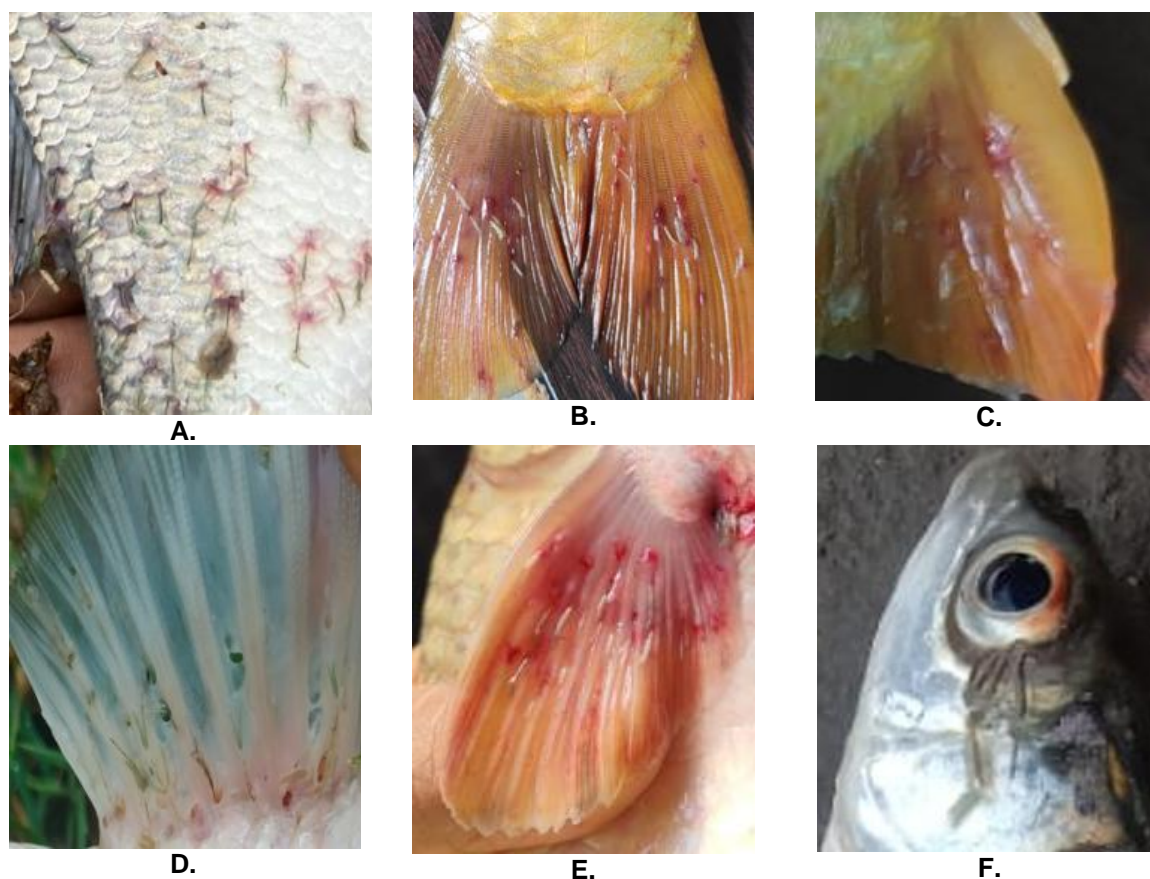


Fig. 2. Lernaean infected organs A. Skin, B. Caudal fin, C. Anal fin, D. Pelvic fin, E. Pectoral fin, F. Eye, operculum, and snout region

Table 1. Records of the selected water quality parameters at different fish farms in Darbhanga and Madhubani District of Bihar

Name of Fish Farm	Temperature (°C)	pH	DO (mgL ⁻¹)	TDS (mgL ⁻¹)	Ammonia (mgL ⁻¹)	Nitrite (mgL ⁻¹)
Sanjay Singh Fish Farm	32.03	7.4	4.0	227	0.25	0
Bhola Singh Fish Farm	31.16	7.2	3.5	288	1.00	0.25
Tuna Mishra Fish Farm	31.13	7.4	4.5	314	1.00	0
Saroj Jha Fish Farm	30.95	7.8	4.0	225	0	0
Rohit Yadav Fish Farm	30.52	7.8	3.5	259	0.50	0.25
Jogeshwar Mukhiya (Mithila Matsya Hatchery)	30.56	7.4	3.0	514	0.25	0.25
Love Mukhiya Fish Farm	32.29	7.2	4.0	223	0.25	0
Mannu Mukhiya Fish Farm	31.99	7.0	3.5	181	0	0
Arun Sahani (Sahyog Matsya Hatchery)	32.60	7.4	4.0	317	0.25	0
Anil Mukhiya Fish Farm	30.86	7.8	3.0	351	0.25	0
Mean	31.04	7.44	3.7	289.90	0.37	0.07

According to the present study, minimum numbers of parasites were found on the smallest fish, and larger numbers were found on the biggest fish. It was observed that as the weight of the fish increases infestation of copepod

ectoparasites also increases. It may be related to the greater surface area on which these parasites can become established in the confined hosts, small fish are seldom infested. The absence or low number of parasites in small

fish may be due to the small size of scales in fishes, where parasites cannot maintain proper hold onto the body of the host [19,23]. The survey revealed the prevalence of parasites increased with an increase in temperature during the summer season. Temperature is considered of great significance, prevalence,

abundance and medium intensity of parasites had a higher seasonal occurrence during warm months. The prevalence and intensity of infestation reduced with decreasing water temperature and increased with increasing water temperature during the summer season [22,24-26].

Table 2. Percentage prevalence of Lernaeid parasite at different fish farms in Darbhanga and Madhubani District of Bihar

Fish Farms	District	Samples	Samples Infected	% Prevalence
Sanjay Singh Fish Farm	Darbhanga	14	3	21.42
Bhola Singh Fish Farm	Darbhanga	16	6	37.50
Tuna Mishra Fish Farm	Darbhanga	13	4	30.76
Saroj Jha Fish Farm	Darbhanga	13	4	30.76
Rohit Yadav Fish Farm	Madhubani	11	2	18.18
Jogeshwar Mukhiya (Mithila Matsya Hatchery)	Madhubani	11	3	27.27
Love Mukhiya Fish Farm	Madhubani	13	7	53.84
Mannu Mukhiya Fish Farm	Madhubani	11	3	27.27
Arun Sahani (Sahyog Matsya Hatchery)	Madhubani	10	4	40.00
Anil Mukhiya Fish Farm	Madhubani	12	7	58.33
Total		124	43	34.67

Table 3. Prevalence of Lernaeid parasite on major carps at different fish farms in Darbhanga and Madhubani District of Bihar

Major Carps	Examined Samples	Infected Samples	% Prevalence
<i>Labeo catla</i>	46	19	41.30
<i>L. rohita</i>	39	11	28.20
<i>Cirrhinus mrigala</i>	39	13	33.33
Total	124	43	34.67

Table 4. Prevalence of Lernaeid parasite in major carps with relation to body weight at different fish farms in Darbhanga and Madhubani District of Bihar

Name of Fish Farm	District	Avg. Wt. (gm) of fishes	Intensity of Parasitism	Infested Areas
Sanjay Singh Fish Farm	Darbhanga	500 gm	++	skin, fins, gill
Bhola Singh Fish Farm	Darbhanga	50 gm	+	Skin, fins, eye
Tuna Mishra Fish Farm	Darbhanga	700 gm	+++	Skin, fins, eye
Saroj Jha Fish Farm	Darbhanga	500 gm	++	Skin, fins, eye, gill
Rohit Yadav Fish Farm	Madhubani	500 gm	++	Skin, fins, gill
Jogeshwar Mukhiya (Mithila Matsya Hatchery)	Madhubani	2000 gm	+++	Skin, fins
Love Mukhiya Fish Farm	Madhubani	1500 gm	+++	Skin, fins, eye
Mannu Mukhiya Fish Farm	Madhubani	1000 gm	+++	Skin, fins
Arun Sahani (Sahyog Matsya Hatchery)	Madhubani	5 gm	+	Skin, fins
Anil Mukhiya Fish Farm	Madhubani	500 gm	++	Skin, fins

Average intensity: (+) = ≤ 4, (++) = 5-9, (+++) = ≥ 10.



Fig. 3. Hotspots of *Lernaea* on fish body

5. CONCLUSION

The prevalence of lernaean parasites in Indian major carp was investigated and it was revealed that *L. catla* is more prevalent and *L. rohita* is less prevalent species to *Lernaea* infestation in IMC. The lernaean ectoparasitic infections were associated with the host body weight and its habitat. The parasitic infestation increased as the body weight of the host increased. In the summer season, *Lernaea* infestation is more prevalent compared to the winter season. These parasites have devastating impacts on fisheries. Although the infected fish are generally considered safe to eat but heavily infested fish are not considered safe to eat and might be used by anglers in tourist and recreational activities. In the future, more studies on host parasites need to be investigated. This study offers a suitable option for the future researchers to follow. Furthermore, these findings can be applied at the local to regional scales. It is suggested that the combination of strategic use of antiparasitic medicine and good management could improve the control of lernaean ectoparasitic infections in fish farms.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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