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Research Article

Prevalence and Identification of *Lernaea cyprinacea* Infesting Major Carps (*Labeo rohita, Catla catla, and Cirrhinus mrigala*) of the River Indus Dera Ismail Khan

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ABSTRACT:

Background: Fish play a critical role in human nutrition, offering high-quality protein, essential fatty acids, and micronutrients. In South Asia, freshwater fish such as *Labeo rohita*, *Catla catla*, and *Cirrhinus mrigala* are extensively cultured and consumed. However, the aquaculture industry faces significant challenges due to parasitic infestations, particularly by ectoparasites like *Lernaea cyprinacea* (anchor worm), which adversely affect fish health, growth, and survivability.

Aim: This study investigates the prevalence, intensity, and morphological identification of *Lernaea cyprinacea* infesting major carps (*Labeo rohita, Catla catla,* and *Cirrhinus mrigala*) collected from the Indus River Dera Ismail Khan (D.I. Khan).

Material and Methods: A total of 119 fish were sampled from river sites over a five-month period. Specimens underwent ectoparasite isolation using scale and gill washes, 54 µm filtration, centrifugation at 6000 rpm for 10 minutes, Giemsa staining, and microscopic examination at 10X magnification.

Findings: A marked seasonal rise was noted, from 7.53% in December to 47.61% in April. Species-specific ratios were *L. rohita* 18.36% (9/49), *C. catla* 20.00% (7/35), and *C. mrigala* 14.28% (5/35). *C. catla* and *C. mrigala* shows the greatest increase (reaching 50% in April), followed by *L. rohita* (42.85%).

Conclusion: The study demonstrates a significant seasonal increase in *Lernaea cyprinacea* infestation among major carps from the Indus River, with peak prevalence in April. *Catla catla* exhibited the highest overall infection rate, followed by *Labeo rohita* and *Cirrhinus mrigala*. These findings highlight the need for timely monitoring and management strategies to mitigate parasitic outbreaks and safeguard aquaculture productivity.

Keywords

Ectoparasite, *Lernaea cyprinacea*, Indus River, *Fish*, Aquaculture Health.

1 | INTRODUCTION

Fish has been a vital source of nourishment for humanity since ancient times. Globally, it is recognized as an important provider of high-quality, balanced, and easily digestible proteins, as well as essential vitamins and polyunsaturated fatty acids. Fish is widely accepted as a key source of animal protein, containing all essential amino acids in appropriate proportions, qualifying as a complete protein source.[1] Additionally, fish have demonstrated antimicrobial properties through peptides that aid in combating harmful human pathogens.[2] Fish and shellfish provide approximately 70% or more of high biological value protein, particularly rich in sulfur-containing amino acids. Fish makes up around 16% of the animal protein consumed worldwide, according to the Food and Agriculture Organisation (FAO) of the United Nations (1997). With 10% in North America and Europe, 17% in Africa, 26% in Asia, and 22% in China, this number varies by area.[3] Due to population expansion and changing consumption patterns, aquaculture is expected to rise by 62% between 2010 and 2030 to supply the growing demand for fish and seafood. Almost two-thirds of the fish and shellfish consumed worldwide are anticipated to come from aquaculture.[4]

Despite the benefits, fish populations are threatened by parasitic infestations and aquatic pollution, both of which pose significant risks to fish health and consequently to human health.[5] Ectoparasites live on or within the skin of host organisms, feeding on tissues, causing irritation and acting as vectors for disease causing pathogens.[6] Consequently, ectoparasites tend to aggregate on high-quality hosts, enhancing their reproductive success and leading to uneven parasite distributions.[7] Host susceptibility to parasitism is shaped primarily by behavioral and immunological defense mechanisms.[8,9] Both of which are influenced by the host's physical condition.[10] Thus, ectoparasites face a trade-off between the resource quality offered by a host and the host's defensive capabilities.[11,12] Hosts in good physical condition may provide superior nutrition but also possess enhanced resistance to infestation.[13] Conversely, hosts in poor condition may be easier to infest but offer limited nutritional benefits, concept referred to as the 'tasty chick hypothesis', making them less attractive for parasitism overall.[14] Fish health research encompasses environmental stressors, genetic variability, histopathology, and pathogenic organisms.[15] Often, pathogens are undetected in healthy fish and are only acknowledged when diseases emerge, leading to substantial economic damage in commercial fisheries.[16] Parasites are a natural part of aquatic ecosystems, existing in dynamic equilibrium with their hosts.[17] However, anthropogenic and environmental changes can disrupt this balance, causing diseases and mass fish mortalities. Parasites can damage fish physically, physiologically, and reproductively. [18,19]

A common condition among freshwater fish raised for fish farming is parasitic infestation. These parasites can reduce fecundity by impeding development and causing deaths.[20] Due to high stocking densities, ectoparasites pose a serious threat to the fish farming sector, especially in intensive fish farming practices.[21] Freshwater fish species are typically infested with Lernaeidae, one of the most prevalent and hazardous groups of ectoparasites. The most common parasite among the Lernaeidae is *Lernaea cyprineacea*, which is said to be more harmful than its sister species. Lernaeid copepods are attached to all exterior and internal parts, including the mouth, gills, filaments, fins, and eyes,[20] cause necrosis, making it susceptible to infections by bacteria, viruses, and fungi.[22] Poor aquaculture management can cause stress, which weakens fish's immune systems and makes them susceptible to microbial and parasite illnesses. Farmers must fight outbreaks of parasite infestations to avoid losses.[23] "Anchor worms," or *Lernaea*, are parasitic crustacean copepods that infect and kill freshwater wild or pond-bred fish. Major carps like Labeo rohita (Rohu), Catla catla (Thela), and Cirrhinus mrigala (Morakhi) have been known to harbour them, as well as Chinese carps such Ctenopharyngodon Idella, Hypophthalmichthys molitrix, and Cyprinus carpio,[24] and from several kinds of ornamental fish.[20] They are particularly prevalent in slow moving or stagnant water during the summer. Globally distributed, Lernaea prefers temperatures between 26 and 30 degrees Celsius.[25]

1.1 | Research Objectives

- Prevalence, Intensity, and Morphological identification of *Lernaea cyprinacea* infesting major carps (*Labeo rohita, Catla catla,* and *Cirrhinus mrigala*) of River Indus D.I. Khan.

2 | MATERIAL AND METHODS

2.1 | Study Area

The present study was conducted in the River Indus, located in district D.I. Khan, Khyber Pakhtunkhwa (KPK), Pakistan. D.I. Khan is a major agricultural region, characterized by extensive plain lands and fertile soils due to the presence of the River Indus. The river supports a diverse aquatic ecosystem and serves as a significant source of fish for the local population, making it an ideal site for studying parasitic infestations in freshwater fish.

2.2 | Sample Collection

Fish specimens were collected from various points along the River Indus between December 2024 and April 2025. The study focused on three economically important freshwater species: *Labeo rohita*, *Catla catla*, and *Cirrhinus mrigala*. Fish were identified using standard taxonomic keys for further examination.

2.3 | Sample Filtration

Fish samples were inspected externally for ectoparasites, particularly on the skin, scales, and gills. These parts were washed with distilled water, and the resulting wash was filtered using filter paper with a 54 µm pore size. The residue on the filter paper, containing potential parasites, was rinsed with distilled water and transferred into Petri dishes. The suspension was collected using a micropipette and stored in eppendorf tubes for centrifugation.

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2.4 | Centrifugation

Samples were centrifuged at 6000 rpm in 10 minutes. Following centrifugation, the supernatant was discarded, and the pellet (containing parasite material) was collected with a micropipette for slide preparation.

2.5 | Slide Preparation

The collected precipitate was carefully placed on clean glass slides and allowed to air dry in a dust-free environment. After drying, Giemsa staining was performed by applying a few drops of stain and allowing it to act for 10 minutes. Slides were gently rinsed with distilled water and covered with a coverslip to complete the preparation.

2.6 | Microscopic Examination

Prepared slides were examined under a compound microscope at 10× magnification for the identification of ectoparasites. Observations were recorded to assess the prevalence and intensity of parasitic infestation among the sampled fish species.

2.7 | Parasite Identification

Under a 10x microscope, the distinctive anchor embedded in host tissue, the four horn-like cephalothoracic processes, slender trunk, and Y-shaped egg sacs are clearly visible. Traditionally the parasites are identified morphologically by using identification keys.[24] Figure.1

Figure 1. Identification key for *L.Cyprinacea*

3 | RESULTS

A total of 119 fish specimens, comprising Labeo rohita (n = 49), Catla catla (n = 35), and Cirrhinus mrigala (n = 35), were collected between December 2024 and April 2025 to assess the prevalence of the ectoparasite (*Lernaea cyprinacea*). Figure.2

Figure 2. *Lernaea cyprinacea* microscopic observation at 10X.

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3.1 | Overall Prevalence of Lernaea cyprinacea

In December, infections were detected only in *Labeo rohita* (8.33%) and *Catla catla* (14.28%), while *Cirrhinus mrigala* showed no cases. January showed a slight decline (5.22%), with low infections in *L. rohita* (6.66%) and *C. catla* (9%). In February, prevalence rose to 17.63%, affecting all three species, including the first cases in *C. mrigala* (18.18%). March recorded a sharp increase (36.50%), with higher rates in *C. catla* (42.85%) and *L. rohita* (33.33%). By April, infections peaked at 47.61%, with *C. catla* and *C. mrigala* both at 50% and *L. rohita* at 42.85%, highlighting a clear upward seasonal trend across species. Table.1,2,3 Graph.1

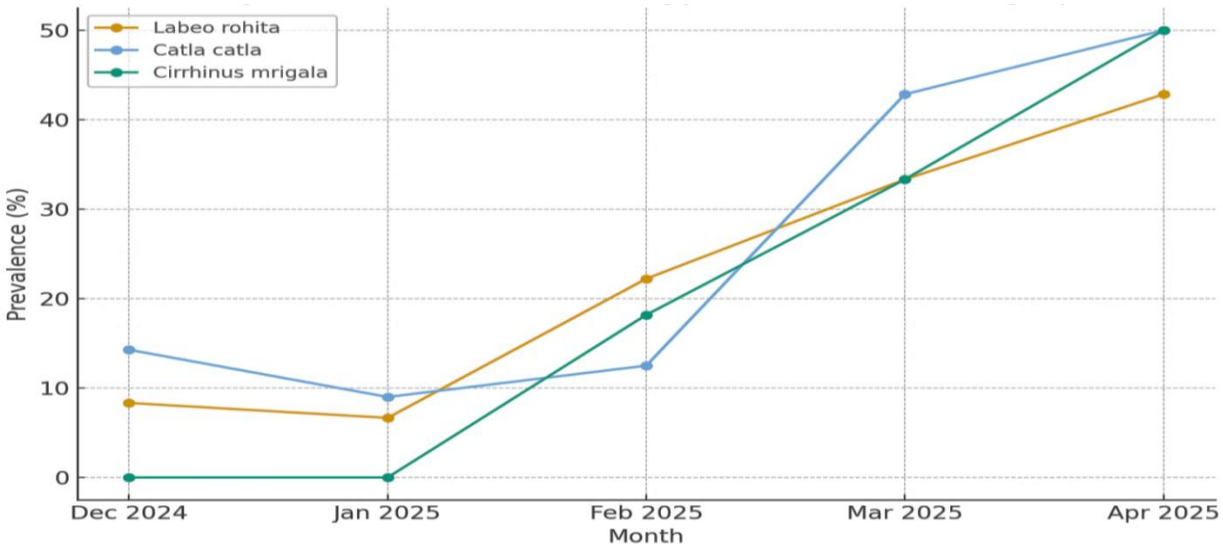

Figure 3. Monthly Prevalence (infection) of *Lernaea cyprinacea* by Species.

Out of the 49 samples of *Labeo rohita* examined, 9 were found to be infected, resulting in a prevalence rate of 18.36%. *Catla catla*, 7 out of 35 samples were infested, showing a prevalence of 20.00% while *Cirrhinus mrigala*, 5 out of 35 samples were infected, corresponding to a prevalence rate of 14.28%. Between December 2024 and April 2025, a total of 119 fish were examined for *Lernaea cyprinacea* infection, with prevalence steadily increasing from 7.53% in December to 47.61% in April. Figure 3.

Table1. Prevalence of *Lernaea cyprinacea* in *Labeo rohita.*

Month	Examined	Infected	Prevalence (%)
December	12	1	8.33%
January	15	1	6.66%
February	9	2	22.22%
March	6	2	33.33%
April	7	3	42.85%

Table 2. Prevalence of *Lernaea cyprinacea* in *Catla catla.*

Month	Examined	Infected	Prevalence (%)
December	7	1	14.28%
January	11	1	9%
February	8	1	12.5%
March	7	3	42.85%
April	2	1	50%

Table 3. Prevalence of *Lernaea cyprinacea* in *Cirrhinus mrigala*

Month	Examined	Infected	Prevalence(%)
December	9	0	0%
January	8	0	0%
February	11	2	18.18%
March	3	1	33.33%
April	4	2	50%

3.2 | Temperature-Dependent Infection Trend

The data demonstrated a clear upward trend in the prevalence of *Lernaea cyprinacea* from winter to spring, suggesting a strong correlation between rising temperature and parasitic infestation. The infection rate rose steadily from 7.53% in December to 47.61% in April. Figure 4

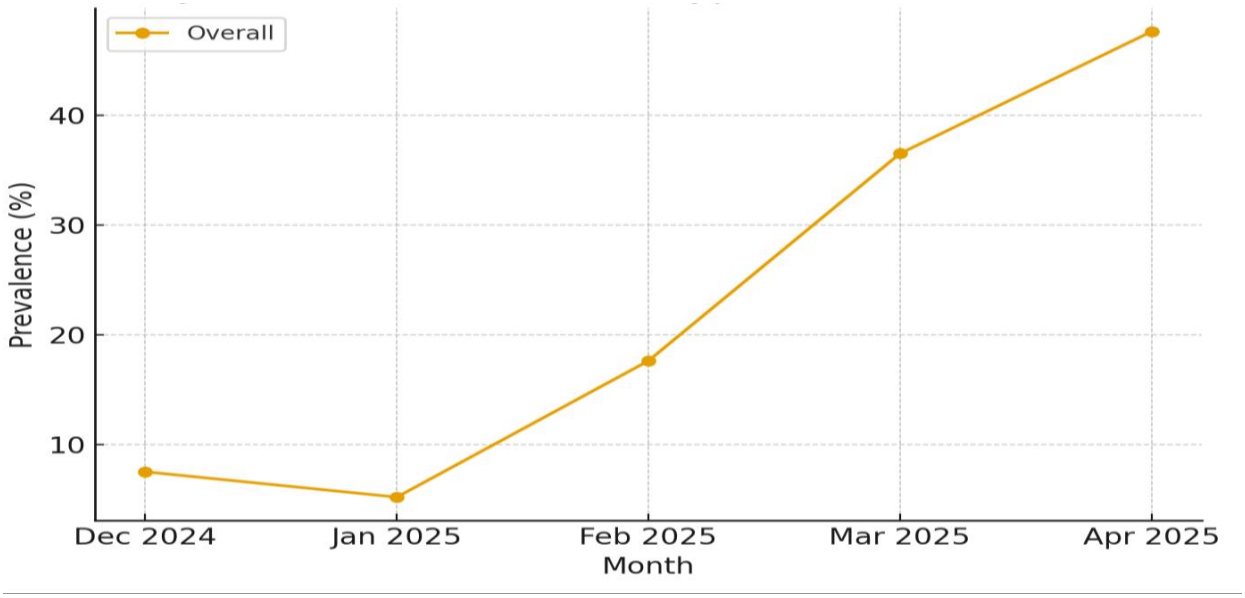

Figure 4. Overall Prevalence of *Larnaea cyprinacea*

4 | DISCUSSION

This study investigated the prevalence of *Lernaea cyprinacea*, an ectoparasitic copepod, in three commercially significant freshwater fish species *Labeo rohita*, *Catla catla*, and *Cirrhinus mrigala* in the River Indus, D.I. Khan, from December 2024 to April 2025. The results demonstrated a clear temporal pattern and interspecific variation in parasite infestation. The infestation of L. cyprinacea was higher in the fish an increased body weight and C. catla was the most infected fish species.[26] A gradual increase in overall parasite prevalence was observed, rising from 7.53% in December to a peak of 47.61% in April. it was found that the parasites were most prevalent in late winter (December to April) when the water temperature was between 13 and 23°C.[24] This seasonal escalation aligns with previous studies linking rising water temperatures to enhanced reproductive and developmental rates of *L. cyprinacea*, facilitating greater host-parasite interactions during warmer months. Among the fish species studied, *Catla catla* exhibited the highest infestation rates, particularly in March and April (42.85% and 50%, respectively). The species' large body surface area and slower mobility may offer a more conducive environment for parasite attachment. *Labeo rohita* also showed a marked rise in infection rates over time, with April exhibiting a prevalence of 42.85%, reinforcing its susceptibility under favorable conditions. *Cirhinus mrigala* displayed resistance in the early months, with zero infections in December and January. However, infection rates increased notably from February onward, reaching 50% in April. This delayed response could be due to species-specific immunity or habitat preferences that initially limited parasite exposure. These observations underscore the importance of seasonal dynamics in parasite transmission. The findings highlight the necessity for proactive, species targeted health management strategies in

aquaculture. Furthermore, the results are consistent with existing literature emphasizing the role of environmental conditions in ectoparasite epidemiology. Future research should aim to explore the influence of additional abiotic factors, such as water pH, dissolved oxygen levels, and fish density, on the life cycle and infestation severity of *L. cyprinacea*.

5 | CONCLUSION

This study concludes that *Lernaea cyprinacea* prevalence in freshwater fish species of the River Indus increases progressively from winter to spring, with the highest infestation rates recorded in April. *Catla catla* was found to be the most susceptible species, followed by *Labeo rohita* and *Cirrhinus mrigala*. The findings suggest a strong seasonal influence on the spread and intensity of infestation, likely driven by rising water temperatures. Routine monitoring, improved water management, and timely intervention could significantly reduce infection rates and associated economic impacts.

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Ethical Approval: Not Applicable
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