

Ecto and Endo Parasite Comparison of Catla Catla and Channa Striata Species Found in Kurnool District, Andhra Pradesh, India

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Abstract

Catla Catla and Channa striata fish samples were collected from various sites of Kurnool district of Andhra Pradesh. This comparative study examines the ectoparasitic and endoparasitic infestations in two freshwater fish species, Catla catla and Channa striata. Both species, common in South Asian freshwater ecosystems, differ in their feeding habits and ecological niches, which influence their susceptibility to parasitic infections. Catla catla a plankton-feeder, is primarily affected by nematodes such as Contracaecum, trematodes like Allocreadium, and ectoparasites such as Dactylogyrus on the gills and Argulus on the skin. In contrast, Channa striata, a carnivorous species, is prone to endoparasites like Clinostomum and Procamallanus, with a lower incidence of ectoparasitic infestations, including Gyrodactylus and Lernaea. The study highlights differences in parasite prevalence and type, with Catla catla showing higher ectoparasitic loads, especially on the gills, and Channa striata demonstrating a broader range of endoparasitic infections due to its predatory diet. This comparison underscores the role of feeding behavior and habitat in shaping parasitic communities in freshwater fish species.

Keywords

Fresh water fishes, Catla catla, Channa striata, Aquatic ecology, Parasite prevalence, Gill parasites, Fish health.

1. Introduction

Parasitic infestations in freshwater fish play a significant role in influencing the health and productivity of aquatic ecosystems. Two economically important freshwater fish species, Catla catla and Channa striata, are commonly found in South Asian rivers, lakes, and ponds (Anwar et al, 2023). These species occupy different ecological niches and feeding habitats, which expose them to varying types of parasitic infections. Understanding the dynamics of these parasitic infestations is crucial for effective fish health management and sustainable aquaculture practices.

Fresh water fishes, commonly known as Catla, is a surface and mid-water feeder, primarily consuming plankton. This dietary preference exposes it to a unique set of endoparasites (internal parasites) and ectoparasites (external parasites), which can cause significant health issues, including reduced growth rates, tissue damage, and mortality. Endoparasites, such as trematodes, nematodes, and cestodes, typically infect the intestines and body cavities, while ectoparasites, such as monogeneans and crustaceans, target the gills, skin, and fins of the fish.

On the other hand, *Channa striata*, known as the striped snakehead, is a carnivorous predator that inhabits freshwater bodies and marshes, feeding on smaller fish, amphibians, and invertebrates. This predatory behavior makes it susceptible to a different spectrum of parasitic infestations (Kaur et al, 2023, Kumar et al. 2023, Maji and Patra, 2023) Although it is prone to some of the same parasitic groups as *Catla*, the prevalence and types of these parasites vary due to differences in diet and habitat.

Catla is one of the three major species used in polyculture systems, along with *Labeo rohita* (Rohu) and *Cirrhinus mrigala* (Mrigala). It is known for its rapid growth, making it a favored species in fish farming. Polyculture with *Catla* allows efficient utilization of different ecological niches in ponds, as it occupies the upper layers while other species inhabit the bottom or middle strata (Ali and Jabeen 2023, Prakash and Sing 2023, Gupta and Sharma 2023, Bhowmik and Rahman 2023, Saha and Mandal . *Catla* breeds during the monsoon season, typically between June and August. In natural conditions, it spawns in large rivers with flowing water, but in captivity, it can be induced to breed using hormone treatments.

Catla is highly valued for its large size, rapid growth, and edible flesh, making it a key species in both local and export markets (Sha and Mandal, 2023, Verma et al, 2024, Roy and Ghosh 2024). It is commonly consumed as food in South Asia and is also used in traditional aquaculture practices to maintain balanced ecosystems in fish ponds. Due to its surface-feeding behavior and plankton-rich diet, *Catla* is prone to various parasitic infections, especially Endoparasites including nematodes (*Contracaecum*, *Camallanus*), trematodes (*Allocreadium*), and cestodes (*Bothriocephalus*). Ectoparasites common infestations include monogeneans (*Dactylogyrus*, *Gyrodactylus*) on the gills and crustacean parasites like *Argulus* (fish lice) and *Lernaea* (anchor worm), which attach to the skin and cause irritation (Choudhury and Nath 2024).

Channa striata

Channa striata, commonly known as the striped snakehead, is a carnivorous freshwater fish species found in rivers, lakes, swamps, and marshes across South and Southeast Asia. It is known for its ability to survive in diverse and harsh aquatic environments, including low-oxygen waters, due to its air-breathing ability (Dutta and Sardar, 2023). This species is economically important for fisheries and aquaculture in several countries in the region.

Key Characteristics:

Scientific Name: *Channa striata*

Common Names: Striped snakehead, Chevron snakehead, Murrel, Shol

Family: Channidae

Habitat: Native to freshwater bodies like rivers, ponds, lakes, swamps, and rice paddies across South Asia and Southeast Asia. It can survive in stagnant, low-oxygen environments due to its capacity to breathe air using a specialized labyrinth organ.

Body Structure: *Channa striata* has an elongated, cylindrical body, with a large head and a mouth filled with sharp teeth. The body is dark brown or black, with distinctive horizontal stripes running along the body.

Size: Can grow up to 1 meter in length, though most commonly found between 30 to 70 cm.

Color: Dark brown to black with white or pale horizontal stripes running along its length, giving it a snake-like appearance.

Feeding Behavior:

Channa striata is a carnivorous predator, feeding primarily on smaller fish, crustaceans, amphibians, and other aquatic invertebrates. Its aggressive nature and ambush-hunting strategy make it an apex predator in many freshwater habitats. It has a voracious appetite and uses its sharp teeth to capture prey efficiently.

While *Channa striata* is less commonly farmed than other species like *Catla*, it has been gaining attention for its potential in aquaculture due to its hardiness and ability to survive in diverse water conditions. Its flesh is highly valued in several parts of South Asia and Southeast Asia, where it is considered a delicacy. The species is also appreciated for its medicinal value, with snakehead extract believed to have properties that promote wound healing.

The striped snakehead breeds during the monsoon season, typically from May to September. It builds bubble nests in shallow water where the eggs are laid, and both parents exhibit parental care by guarding the nest. Unlike some other freshwater species, *Channa striata* shows strong survival instincts, with the young remaining close to the parents until they are capable of independent survival.

Channa striata is a highly prized food fish, particularly in Southeast Asian countries like Thailand, Indonesia, and Vietnam, where it is sold fresh and used in traditional dishes. Its air-breathing capability and resilience make it an important species in low-maintenance aquaculture systems, particularly in regions with less developed water management systems.

Due to its carnivorous nature and preference for preying on other fish and amphibians, *Channa striata* is prone to a range of parasitic infestations, including:

Endoparasites common endoparasites include trematodes (*Clinostomum*, *Euclinostomum*) that infect the muscles and subcutaneous tissues, as well as nematodes like *Procamallanus* and *Philometra* found in the gastrointestinal tract and body cavity.

Ectoparasites ectoparasitic infestations are less frequent in *Channa striata* compared to other fish species, but include monogeneans (*Gyrodactylus*, *Dactylogyrus*) and crustacean parasites (*Argulus*, *Lernaea*), which may infect the skin, fins, and gills.

One of the most notable traits of *Channa striata* is its ability to survive in harsh environmental conditions. The species can withstand periods of drought by burrowing into the mud and breathing air, enabling it to survive in oxygen-deprived habitats. This adaptability makes *Channa striata* a resilient species in ecosystems prone to water level fluctuations.

2. Compare Fresh water fishes Based on Ecto and Endo Parasite

Fresh water fishes (commonly known as Catla) and *Channa striata* (commonly known as striped snakehead) are freshwater fish species with different ecological niches and feeding habits. Both species can be affected by parasites, but they differ in the type and prevalence of endoparasites (internal parasites) and ectoparasites (external parasites). Freshwater rivers and lakes, especially in South Asia. Primarily a surface and mid-water feeder, feeding on plankton. Several species of trematodes, such as *Allocreadium* and *Trematoda* sp., have been reported. These parasites usually infect the intestine and liver of the fish. Tapeworms like *Bothriocephalus* species can also infest Catla, attaching themselves to the intestinal walls. *Dactylogyrus* and *Gyrodactylus* species are common on the gills and skin of Catla. They can cause significant damage, leading to gill hyperplasia and respiratory distress. *Argulus* (fish lice) and *Lernaea* (anchor worm) are common ectoparasites that attach to the skin, fins, and gills of the fish, causing irritation and sometimes secondary infections.

Freshwater bodies, including rivers, ponds, and marshes, with the ability to survive in low-oxygen environments due to its ability to breathe air. Carnivorous, primarily preying on smaller fish, amphibians, and invertebrates. *Clinostomum* and *Euclinostomum* are common in the muscles and subcutaneous tissues of *Channa striata*. Species such as *Procamallanus* and *Philometra* are found in the body cavity and gastrointestinal tract. Tapeworm species like *Proteocephalus* may infest the intestines, although they are less common compared to other endoparasites. *Gyrodactylus* and *Dactylogyrus* are found on the gills and skin of the snakehead, though these parasites are less prevalent in *Channa striata* compared to Catla. Like Catla, *Channa striata* can be infested by *Argulus* and *Lernaea*, though these are less frequently reported in this species.

Endoparasites: Both Catla and *Channa striata* host a variety of trematodes and nematodes, but their parasitic profiles differ slightly due to their feeding habits and ecological environments. Catla, being a plankton feeder, is more prone to nematodes like *Contraecum*, while *Channa*, being carnivorous, is more likely to host parasites associated with the ingestion of infected prey, such as *Clinostomum*.

Ectoparasites: Both species are affected by monogeneans and crustacean parasites. However, Catla has a higher prevalence of gill parasites, possibly due to its surface-feeding behavior, while *Channa striata* may encounter fewer external parasites due to its more aggressive and solitary nature (Table 1).

Table 1. Fresh water fishes Based on Ecto and Endo Parasite

Feature	Fresh water fishes	Channa striata
Scientific Name	Fresh water fishes	Channa striata
Common Name	Catla	Striped Snakehead
Feeding Behavior	Planktivorous (feeds on plankton)	Carnivorous (feeds on small fish, amphibians, invertebrates)
Habitat	Rivers, lakes, reservoirs (well-oxygenated water)	Rivers, swamps, ponds (can survive low-oxygen environments)
Endoparasites	Trematodes: Allocreadium, Trematoda sp. Nematodes: Contraecum, Camallanus Cestodes: Bothriocephalus sp.	Trematodes: Clinostomum, Euclinostomum Nematodes: Procammallanus, Philometra Cestodes: Proteocephalus (less common)
Ectoparasites	Monogeneans: Dactylogyrus, Gyrodactylus (gills) Crustaceans: Argulus (fish lice), Lernaea (anchor worm)	Monogeneans: Gyrodactylus, Dactylogyrus (gills) Crustaceans: Argulus (fish lice), Lernaea (anchor worm) (less common)
Prevalence of Ectoparasites	High, particularly on gills due to plankton-feeding behavior	Lower prevalence compared to Catla, with less frequent infestations of gills and skin
Endoparasite Susceptibility	Primarily affected by intestinal and body cavity nematodes and trematodes due to plankton diet	Higher variety of endoparasites due to predatory diet and consumption of infected prey
Adaptability	Moderate; prefers well-oxygenated environments	Highly adaptable; can breathe air and survive in low-oxygen and dry conditions
Aquaculture Significance	Widely farmed; fast-growing and economically valuable	Increasing in aquaculture; valued for its resilience and flesh quality

3. Literature Survey Analysis

The literature on parasitic infestations in freshwater fish species, particularly *Catla catla* and *Channa striata*, highlights key findings regarding their susceptibility to ectoparasites and endoparasites. A thorough review of research reveals variations in parasitic infestations due to differences in feeding habits, ecological conditions, and host-parasite dynamics. This section summarizes and analyzes the significant findings from existing literature. Fresh water fishes, being a surface and mid-water plankton feeder, is primarily infected by nematodes like *Contraecum* and trematodes

such as *Allocreadium* in the intestines and body cavities. Studies show that parasites are often ingested through contaminated plankton-rich water.

Channa striata, due to its predatory nature, harbors a wider range of endoparasites, particularly trematodes such as *Clinostomum* and nematodes like *Procamallanus*, which are transmitted via infected prey. Researchers argue that this is due to the species' piscivorous diet, exposing it to prey that already carry parasites. Literature shows that Fresh water fishes is more frequently affected by ectoparasites, particularly monogeneans like *Dactylogyrus* and crustaceans like *Argulus* (fish lice). Studies link this high prevalence to its surface feeding behavior, making it more susceptible to parasitic organisms in the water column. In contrast, *Channa striata* is less prone to ectoparasitic infections, particularly in the wild, though it may still suffer infestations from species such as *Gyrodactylus*. Researchers attribute its lower ectoparasitic load to its aggressive and solitary behavior, which reduces the chances of parasite transmission.

Fresh water fishes is commonly farmed in polyculture systems, where its interactions with other species increase exposure to parasitic infestations. Studies suggest that the quality of water in such systems directly impacts parasite prevalence. Poor water management can lead to higher ectoparasitic loads, particularly of gill-infecting monogeneans and crustaceans. *Channa striata* thrives in diverse water bodies, including marshes and low-oxygen environments, due to its ability to breathe air. Literature suggests that this adaptability reduces ectoparasitic infestations but does not prevent endoparasites, which are commonly transmitted through the food chain.

Fresh water fishes has a relatively lower resistance to ectoparasitic infections, particularly monogeneans on the gills. The high parasite load can lead to tissue damage, impaired growth, and secondary bacterial infections, making this species vulnerable in aquaculture settings. *Channa striata* demonstrates a higher resilience to parasites, possibly due to its evolved immune responses as a predator in challenging environments. Studies show that although it harbors various endoparasites, it exhibits fewer clinical symptoms compared to other freshwater species, suggesting a more robust natural defense system.

Fresh water fishes suffers significantly from ectoparasitic infestations in aquaculture systems, particularly in poorly managed ponds. Infected fish often exhibit reduced growth, tissue damage, and respiratory issues due to gill infestations. Researchers recommend improved water quality management and regular parasite monitoring to mitigate losses. *Channa striata* has garnered attention for its hardiness and resilience in aquaculture, despite parasitic challenges. Studies show that this species, though prone to endoparasites, thrives in environments with minimal intervention, making it a valuable species for sustainable, low-maintenance farming.

The use of medicated feeds, antiparasitic treatments, and biological controls to manage parasitic loads in Fresh water fishes farms. Preventative measures such as proper pond management, water quality control, and stocking density regulation are critical to reducing ectoparasitic infestations. In *Channa striata*, while there is less focus on intensive control measures due to its resilience, researchers recommend monitoring for nematodes and trematodes, particularly in farms using wild-caught broodstock. Probiotic treatments have also been explored as a natural method to enhance immune response and reduce parasitic loads.

4. Existing Approches

Over the years, various approaches have been developed to control and manage parasitic infestations in freshwater aquaculture, specifically for species like Fresh water fishes and *Channa striata*. These approaches focus on reducing both ectoparasites and endoparasites to ensure healthy fish stocks, improve growth rates, and prevent economic losses. The existing strategies can be broadly classified into biological, chemical, and environmental management techniques. Biological control methods are increasingly being explored to manage parasitic infestations in aquaculture systems. These involve using natural enemies of parasites or promoting the immune response of the fish to combat parasitic infections.

Probiotic treatments, particularly in Fresh water fishes aquaculture, have been studied to enhance immune responses. Probiotic strains like *Lactobacillus* and *Bacillus* species can improve the overall gut health of the fish and boost their resistance to parasitic infections, particularly endoparasites. Immunostimulants, such as β -glucans and chitosan, have

been used to enhance the innate immune system of both species, helping them better resist parasitic infections like nematodes (*Contracaecum*) and trematodes (*Clinostomum*).

In Fresh water fishes farming. Some research suggests that promoting natural predator species in the farming environment of *Channa striata* can help reduce the population of parasite hosts, thereby decreasing the chances of parasitic transmission. Chemical treatments are among the most commonly used methods for managing parasitic infestations in aquaculture. These treatments can target both ectoparasites and endoparasites, though they need to be carefully managed to avoid environmental impacts and fish health issues.

Levamisole and praziquantel are commonly used to treat endoparasitic infections in both Fresh water fishes and *Channa striata*. These drugs effectively target intestinal nematodes and trematodes. In *Channa striata*, Albendazole and Fenbendazole have been tested to eliminate nematodes like *Procamallanus* and *Philometra*. These anthelmintics can be administered through medicated feed or directly into the water system for mass treatments. Potassium permanganate and formalin are commonly used as dip or bath treatments for managing ectoparasitic infections like monogeneans and crustacean parasites (*Argulus*, *Lernaea*) in Fresh water fishes. These chemical treatments are effective in controlling surface parasites on the skin and gills.

In *Channa striata*, copper sulfate and sodium chloride are used to reduce the load of ectoparasites such as *Gyrodactylus* and *Dactylogyrus*. Organophosphates, such as trichlorfon, are used to control crustacean ectoparasites like *Argulus* and *Lernaea* in Fresh water fishes aquaculture. This method is often combined with periodic pond treatments to ensure the entire lifecycle of the parasite is interrupted.

5. Proposed Method

To comprehensively understand and manage parasitic infestations in Fresh water fishes and *Channa striata*, this proposed method integrates a multi-tiered approach combining biological, environmental, and chemical strategies. The goal is to develop a robust framework for diagnosing, monitoring, and mitigating both ectoparasitic and endoparasitic infections in these fish species, while reducing reliance on chemical treatments and enhancing sustainability in aquaculture systems. A fundamental aspect of the proposed method involves the systematic collection and examination of fish samples from multiple aquaculture sites and natural habitats. Collect a statistically significant number of fish from various regions (rivers, lakes, farms) and at different time intervals to account for seasonal variations in parasitic load. Both Fresh water fishes and *Channa striata* will be sampled from polyculture systems, monoculture systems, and wild populations to ensure diversity.

Use microscopic examination of gill smears, skin scrapings, and intestinal contents to detect ectoparasites (e.g., *Gyrodactylus*, *Dactylogyrus*) and endoparasites (e.g., nematodes, trematodes). Implement molecular diagnostic tools such as PCR (Polymerase Chain Reaction) to identify parasite species at the genetic level, providing greater accuracy in detecting parasite stages not visible to the naked eye. Create a comprehensive parasitic database to categorize identified parasites by species, host, and geographic location. The interaction between environmental factors, host biology, and parasite prevalence needs to be thoroughly studied to develop effective parasite management protocols. Measure key water quality parameters such as dissolved oxygen, pH, temperature, and ammonia levels in aquaculture environments to correlate parasite loads with environmental stressors.

Analyze the habitat types of wild *Channa striata* and Fresh water fishes populations to evaluate how different ecosystems impact parasite infestation rates (e.g., swampy low-oxygen waters vs. flowing rivers). Conduct studies on the immune responses of both species to different parasite types. Analyze blood samples to measure levels of immunoglobulins and antioxidant enzymes that indicate the fish's ability to resist infections. Investigate how host factors such as feeding behavior, age, and genetic variations influence parasitic susceptibility. Focus on determining which genetic traits provide resistance to specific parasites in each species. The proposed integrated parasite management protocol (IPMP) seeks to combine preventative, biological, and selective chemical control methods to reduce parasite loads in both Fresh water fishes and *Channa striata*.

Preventative strategies aim to minimize parasite introduction and spread within aquaculture environments. Implement pond drying and liming practices prior to stocking to reduce parasitic stages present in sediment and water. Screen and quarantine broodstock to prevent the introduction of parasites into the system. Routine health checks of new fish

stock are essential to control parasite transmission. Regularly monitor and adjust water parameters to ensure optimal conditions for fish health. Implement aeration systems to maintain high dissolved oxygen levels and reduce parasite survival rates, especially for gill parasites. Biological control is proposed to limit the use of chemicals and foster a more sustainable aquaculture environment. Incorporate probiotics like *Lactobacillus* and *Bacillus* species into fish feed to boost the immune systems of both Fresh water fishes and *Channa striata*, thereby enhancing their resistance to both endo and ectoparasites.

Develop species-specific probiotic formulations tailored to the gut microbiome of each fish species to improve digestion, growth, and parasitic resistance. Explore the use of herbal extracts (e.g., neem, garlic, turmeric) as antiparasitic agents. Several studies indicate the efficacy of such extracts in reducing parasitic loads while being less harmful than synthetic chemicals. Conduct *in vivo* and *in vitro* trials to test the effectiveness of these natural compounds against common ectoparasites (e.g., *Argulus*) and endoparasites (e.g., nematodes). Chemical treatments remain necessary for managing high levels of parasite infestations, particularly in intensive aquaculture systems. Use levamisole and praziquantel as targeted treatments for endoparasites, particularly during critical periods of parasite infestation. Implement these treatments in a strategic manner, reducing overall chemical dependency by combining them with biological controls.

Potassium permanganate and formalin baths will be used sparingly to control ectoparasites like *Dactylogyrus* and *Gyrodactylus*, ensuring the treatment regime does not affect water quality or the fish's health. A robust monitoring and feedback system is crucial for adaptive parasite management. Implement real-time sensors in aquaculture ponds to track water quality parameters, parasite loads, and fish health. Data from these sensors will be continuously analyzed to detect early warning signs of parasitic outbreaks. Introduce automated parasite scanning systems that use AI-driven image recognition tools to identify parasite infestations from gill and skin scans.

Use machine learning algorithms to analyze the collected data and predict future parasitic outbreaks. Factors such as water temperature, pH changes, and fish stocking density will be used to forecast parasite risks. Establish a decision support system (DSS) that advises aquaculture managers on the optimal timing for treatments, stocking densities, and environmental adjustments based on real-time data analysis. Selective breeding to enhance natural parasite resistance is proposed as a long-term strategy.

Identify individuals of Fresh water fishes and *Channa striata* with higher resistance to parasites (both ectoparasites and endoparasites) through genetic marker analysis. These individuals will be prioritized in selective breeding programs to improve future stock resilience. Collaborate with aquaculture geneticists to develop cross-breeding programs that combine desirable traits, such as fast growth rates and parasite resistance, particularly in *Channa striata*, which has proven resilient to adverse environments.

6. Result

Nearly 150 fish samples of *catla catla* and *channa striata* were collected for identification of endo and ecto parasites from different water body of kurnool district, Andhra Pradesh (Figure 1- Figure 4) and Table 2 and Table 3.

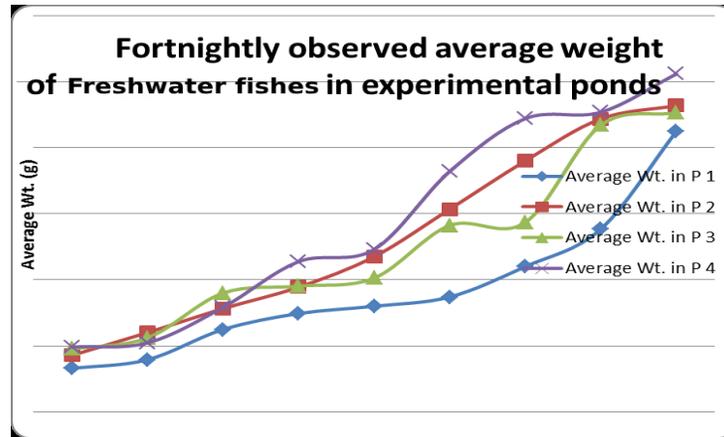


Figure 1. Fortnightly average weight of Fresh water fishes in experimental ponds.

Nearly 150 fish samples of catla catla and channa striata were collected for identification of endo and ecto parasites from different water body of kurnool district, Andhra Pradesh (Figure 1- Figure 4) and Table 2 and Table 3.

Table 2. Identified parasitic species from catla catla during the study period from June 2022 to December 2023.

Name of the Host	Name of the parasite	Site of Infection	No of fishes examined	No of fishes Infected	No of Parasites	Prevalance P%	Mean Intensity (MI)
Catla catla	Ecto parasites						
	Monogeneans:						
	1.Dactylogyrus	Skin	150	20	41	13.3	2.0
	2.Gyrodactylus	Gills	132	12	26	9	2.2
	Crustaceans						
	3.Argulus		120	10	22	8.3	2.2
	Copepod						
	4. Lernaea	Gills	142	6	14	4.2	2.3
	Endo parasites						
	Trematodes						
	1.Allocreadium	Intestine	125	4	7	3.2	1.75
	Cestodes						
	2.Bothriocephalus sp.	Gut	130	6	11	4.6	1.83
	Nematodes						
3.Contracaccum	Intestine	120	4	6	3.3	1.5	
4. Camallanus	Intestine	135	6	10	4.4	1.6	

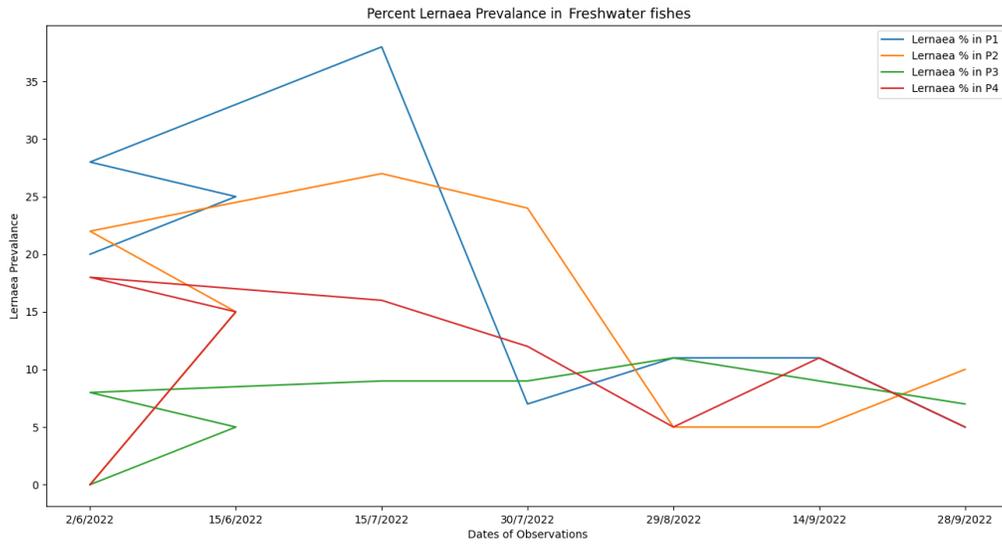


Figure 2. Lernaea prevalence in Fresh water fishes.

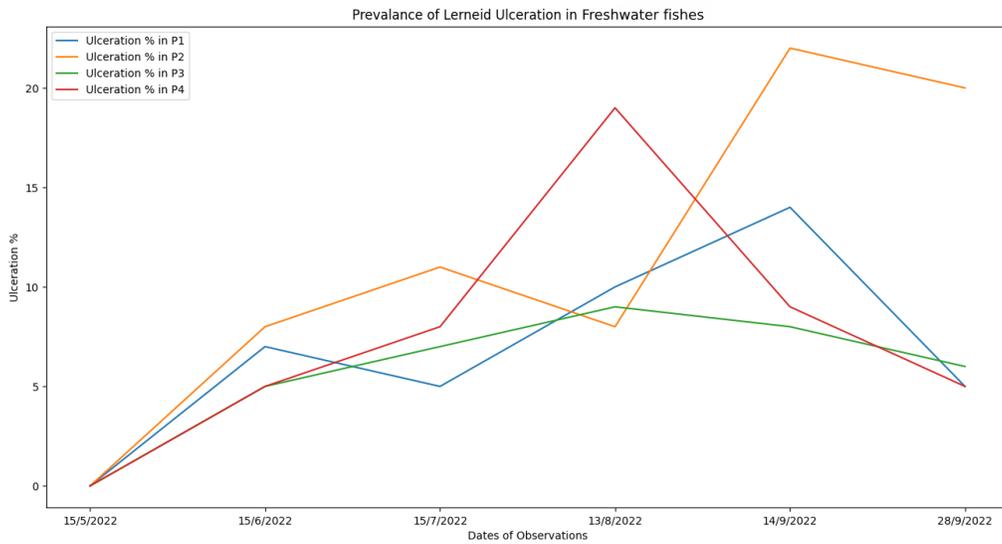


Figure 3. Ulceration prevalence in Fresh water fishes.

Table 3. Identified parasitic species from channa striata during the study period from July 2022 to December 2023.

Name of the Host	Name of the parasite	Site of Infection	No of fishes examined	No of fishes Infected	No of Parasites	Prevalance P%	Mean Intensity (MI)
Channa striata	Ecto parasites						
	Monogeneans:						
	1. Gyrodactylus	Gills	150	6	11	4	1.8
	2. Dactylogyrus	Skin	145	5	8	3.4	1.6
	Crustaceans						
	3. Argulus	Skin	130	5	10	3.8	2
	Endo parasites						

Acanthocephala							
1.Pallisentis ophcephali	Intestine	143	15	40	10.5	2.7	
Digenea							
2.Allocreidium species	Intestine	135	16	35	11.8	2.2	
3.Genarchopsis species	Intestine	142	18	41	12.6	2.3	
Nematoda							
4.Pro camallanus sp.	Intestine	145	12	26	8.4	2.2	
5.camallanus	Intestine	140	14	34	10	2.4	

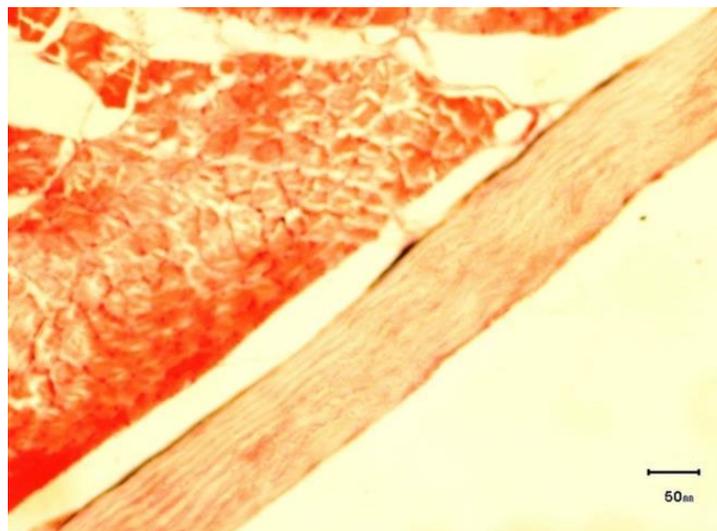


Figure 4. Skin of healthy Catla catla.

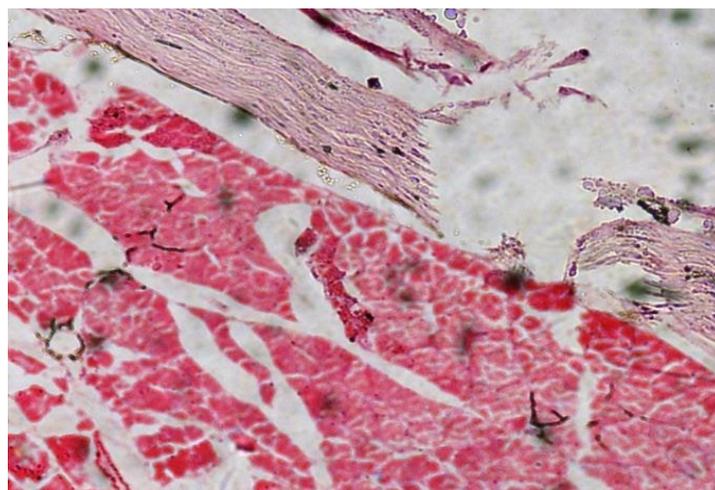


Figure 5. Skin of infected Catla catla.

Figure 4, Figure 5 showed that the parasitic infestation enhanced the host's immunity (white blood cells) against the lernaea infestation in *C. catla*, hence increasing the host's response to infection. Infected fish developed hemolytic anemia as a result of red blood cell destruction, which also increased the ESR value and increased hemoglobin release.

7. Conclusion

The comparative analysis of *Catla catla* and *Channa striata* concerning ecto and endoparasitic infestations highlights the complexities of parasitic interactions within freshwater ecosystems and aquaculture systems. Both species exhibit distinct susceptibility and resistance patterns to various parasites, influenced by their ecological niches, physiological characteristics, and environmental conditions. Fresh water fishes, as a herbivorous fish, is more prone to ectoparasitic infections, particularly from monogeneans like *Dactylogyrus* and crustaceans such as *Argulus*. This vulnerability can be attributed to its feeding habits and gill morphology, which provide a conducive environment for ectoparasites. On the other hand, *Channa striata*, a carnivorous species, often harbors endoparasites like nematodes and trematodes due to its predatory lifestyle and the types of prey it consumes. The proposed integrated management strategies, combining biological controls, environmental management, targeted chemical treatments, and genetic selection, can significantly reduce parasitic loads in both species. Implementing these strategies will not only enhance fish health and growth but also improve the sustainability of aquaculture practices.

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