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Population Dynamics of Copepod Parasites, *Lernaea* (Anchor worm) and its Impact on Haemato-biochemical indices of *Channa punctata* (Bloch)

[1]Sadguru Prakash*, [2]Lavi Jaiswal and [3]Dilip Kumar Yadav

Author's Affiliation:
[1]Department of Zoology, M.L.K.P.G. College, Balrampur, Uttar Pradesh 271201, India
[2]Department of Zoology, Baikunthi Devi Kanya Mahavidyalaya Agra Uttar Pradesh 282001, India
[3]Research Scholar, Department of Zoology, K.S. Saket P.G. College, Ayodhya, Uttar Pradesh 224123, India

***Corresponding author:**
Sadguru Prakash
Department of Zoology, M.L.K.P.G. College, Balrampur, Uttar Pradesh 271201, India
E-mail: sadguruprakash@gmail.com

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ABSTRACT:
Lernaea is a common ectoparasitic copepod and causes lerneosis in several freshwater fishes. It causes high mortality in freshwater fishes. The prevalence of *Lernaea* infection were decreased with increasing size of host fish, *Channa punctata* whereas the mean intensity and density or abundance were increased with increasing the size of host fish. The maximum prevalence of *Lernaea* parasite in *Channa punctata* was recorded during summer and the minimum during winter but the mean intensity and density or abundance was maximum in winter and minimum in autumn seasons. RBC count, haemoglobin, Packed Cell Volume, serum protein and lipid level were found decreased in the fishes infested with *Lernaea* as compared to those which were devoid of infestation. Similarly, TLC, and Serum Glucose were found increased in parasitized fishes than non-parasitized ones. The results indicated that fishes suffer anaemia, loss of appetite and reduced growth when affected with *Lernaea*.

Keywords:
Prevalence, Intensity, Density, Haemato-biochemical indices, *Channa punctate*

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INTRODUCTION

Parasitism is the most common lifestyle of a parasitic animals on the planet, understanding its role in the environment may help researchers to understand the changes in their host population of a particular ecosystem. Fishes are rich in different types of Nutrients and get infection from various kinds of parasites frequently (Peddinti *et al*., 2021). Fish serve as hosts to a range of parasites that typically exhibits significant taxonomically diversity depending on the environment in which fish live (Prakash and Singh, 2020). Parasites are ubiquitous, primarily surviving in a dynamic equilibrium with their hosts and they are often overlooked in fish health assessments. Any changes in the environment, can alter the parasite/host equilibrium and cause disease or mortality in fishery pond because parasites have the potential to induce death and illness in cultivable fishes, which would greatly reduce fish production as well as economic loss to cultivators (Prakash and Verma, 2017). So, it is important that fish cultivators have knowledge of both parasites and parasitic communities within a given population before fish culture because damage and mortality rate of fishes in pond often be associated with changes in parasite density,

rate of infestation by parasite and community composition. Parasites can cause mechanical damage (fusion of gill lamellae, tissue replacement), physiological damage (cell proliferation, immunomodulation, detrimental behavioural responses, altered growth) and reproductive damage. Diseases are the most important limiting factors in pisciculture, due to the increased fish density in small waterbodies where fish pathogens or parasites can easily transmit from one fish to another (Prakash *et al*., 2011).

Potential hosts may also change their behaviour during the infectious stage of parasite if the hosts adopt tactics to reduce the risk of exposure. In fact, the infections of parasite can also stimulate fish to perform certain types of simple or complex behaviours, such as scratching the substrate or visiting cleaning stations. Different ectoparasitic forms of fish have a direct life cycle and permit transmission from host to host are the primary causes of fish diseases in fish pond (Prakash and Verma, 2020). Some parasites are serious pests for capture fishes, while others can harm to farmed fishes. The success of the fisheries development project and the blue revolution, on the other hand, depends on the strengthening of fish parasitological research, because a healthy fish population is the main condition for increasing fish productivity (Prakash *et al*., 2021).

The most popular cultured freshwater fish in eastern Uttar Pradesh are major indigenous and exotic carp due to the easy availability of fish seeds (Parmar and Prakash, 2024). Parasites can also affect the energy metabolism of their hosts, in most host-parasite systems; parasitism increases the host's metabolic rate (Radwan *et al*., 2021).

There is a close relationship between parasitic communities and water pollution levels. In a polluted aquatic environment, the prevalence and intensity of parasites can be an indicator of water quality of a waterbody. Because levels of water pollution can directly or indirectly affect aquatic ectoparasites through the activities of their intermediate host, ectoparasites in direct contact with water may be more sensitive to pollutants, reducing their survival and reproductive rates (Dimovska and Stojanovski, 2022). Extreme types of parasitic contaminations are frequently coming about from the antagonistic impact of the climate. Therefore, proper fish health management is necessary to stop the economic loss and maintain the current fish production.

Anchor worm, *Lernaea* sp. a common ectoparasitic copepods that can infect and cause disease and death in many types of freshwater fishes, especially wild-caught and are more common in stagnant or slow-moving polluted water bodies. Skin, fins, gills, and buccal cavity of fishes are the common sites of *Lernaea* infection. Large numbers of lernids stage of *Lernaea* can kill small fish, damaging their gills and making it difficult for the fish to breathe.

Haematological parameters constitute an important tool that reveals the physiological status of fish and help in evaluation of the immune system. Parasitism induces haematological alteration that affect the natural immune status of fish (Nashaat and Maghawri, 2022). Haemato-biochemical parameters are related to metabolic activities (energetic), respiration (haemoglobin), and defence mechanisms, acting as physiological indicators to changing external conditions (Parmar and Prakash, 2022; Prakash and Verma, 2022).

Considering the above facts, the objective of present investigation to assess the prevalence, mean intensity and density or abundance of *Lernaea* sp., a cestodian ectoparasite in *Channa punctata* collected from Sawan Nallaha, a polluted lotic waterbody of Balrampur, U.P., and also to assess the impact of *Lernaea* sp, a copepodian ectoparasite on haemato-biochemical parameters of infected fish, *Channa punctata*.

MATERIAL AND METHODS

One sixty-four snake headed freshwater fish, *Channa punctata* (Bloch) of different size were collected from Sawan Nallaha of Balrampur during different seasons *i.e*. Spring, Summer, Winter and Monsoon and transported to Ichthyology Lab, Department of Zoology, M.L.K.P.G. College, Balrampur. The fishes were examined immediately after collection for the investigation of Anchor worm, *Lernaea* a

ectoparasitic copepods. For investing and collecting the anchor worm, the external surface such as scales, fins, skin and fin base of freshly collected *Channa punctata* were examined carefully with the help of magnifying lensed. The scrapping of the skin was done by a scalpel to collect the mucus in a petri dish for microscopic examination. After that gills were removed from the branchial cavity and placed on a glass slide for microscopic examination. From this, anchor worms were collected by a hairbrush.

A total of 164 live *Channa punctatus* of different sizes were collected seasonally from October 2022 to September 2023 and after collection transferred alive to the laboratory. In the laboratory, the collected live fishes were divided into three categories viz., small (6.5-8.0 cm), medium (8.0 – 9.5cm) and large (above 9.5 cm) categories then clinical examination of these collected live fishes was done. Fish specimens under investigation were grossly examined for determination of any clinical sign and *Lernaea,* a external copodian parasites.

Prevalence, Mean intensity and Relative density or Abundance of infection were calculated by formula given by Margolis *et al*. (1982).

$$\text{Prevalence \%} = \frac{\text{Total no. of infected fishes}}{\text{Total no. of fish examined}} \times 100$$

$$\text{Intensity of Infection} = \frac{\text{Total no. of parasites collected}}{\text{Total no. of infected fish examined}}$$

$$\text{Density of Infection} = \frac{\text{Total no. of parasites collected}}{\text{Total no. of fish examined}}$$

Channa punctata infected by *Lernaea* spp.

Anchor worm, *Lernaea* sp.

Blood sample was collected from the heart of infected and uninfected live fishes using 2 ml plastic syringe and needle treated and preserved with EDTA (ethylene diamine tetra acetate, an anticoagulant). The blood parameters like total RBC, TLC, Hb% and PCV were analyzed according to the methods of Dacie and Lewis (1977). Blood Glucose was analyzed by ISO certified Glucometer. For the estimation of serum protein and lipid, the blood samples were centrifuged at 300 rpm for 10 minutes and the serum collected for biochemical analysis. Protein and triglyceride were analyzed according to the Lowry's methods (1951) and Barnes and Blackstock method (1973), respectively. The data obtained were subjected to statistical analysis.

RESULT AND DISCUSSION

Table 1: Population dynamics of Copepd, *Lernaea* ectoparasite in different length group of Snake headed fish, *Channa punctata* sp.

Seasons	Length group of fishes (cm)	No. of Fish Examined	No. of fish infected	Total number of fish parasites recorded	Prevalence (%)	Mean Intensity of infection	Density or Abundance of Parasite
Spring	Small	13	4	6	30.76	1.50	0.46
	Medium	16	3	8	18.75	2.60	0.50
	Large	11	2	6	18.18	3.00	0.55
	Total	**40**	**9**	**20**	**22.50**	**2.22**	**0.50**
Summar	Small	14	5	7	35.71	1.40	0.50
	Medium	15	4	8	26.66	2.00	0.53
	Large	13	3	8	23.07	2.66	0.62
	Total	**42**	**12**	**23**	**28.57**	**1.92**	**0.55**
Autumn	Small	10	2	3	20.00	1.50	0.30
	Medium	16	3	5	18.75	1.67	0.31
	Large	12	2	4	16.66	2.00	0.33
	Total	**38**	**7**	**12**	**18.42**	**1.71**	**0.32**
Winter	Small	8	1	2	12.50	2.00	0.25
	Medium	17	2	5	11.76	2.50	0.29
	Large	19	2	6	10.52	3.00	0.32
	Total	**44**	**5**	**13**	**11.36**	**2.60**	**0.29**

Lernaea in freshwater fish, cause a disease called lerneosis. *Lernaea cyprinacea* is a cosmopolitan copepod parasite and found in many freshwater fishes (Kabata, 1979). This parasite has a wide range of hosts and is registered in more than 100 fish species, from 25 families and 10 orders. *Lernaea cyprinace*a has been identified in more than 45 cyprinid fish species, which in Europe are major hosts of this parasite (Lester *et al*., 2006).
In the present study this parasite was found on the skin, fin and gills of *Channa punctata*. Presence of this ectoparasite on skin and fins of indigenous and exotic carps was also reported by (Prakash *et al*., 2021). The highest prevalence of *Lernaea* in the fish *Channa punctata,* was observed in the small sized fish during summer and the lowest prevalence was determined in the larger sized fishes.

Fish fingerlings become more susceptible to pathogen because of their immature immune system (Mortuza and Al-Misned, 2015), which support the present findings.

The maximum prevalence of infection of *Lernaea* was observed in summer season followed by spring, autumn and winter (Table 1). Results of this study suggested that, the prevalence of *Lernaea* infection were decreased with increasing sized group whereas, mean intensity and density or abundance of *Lernaea* increased with increasing size of fishes resulting the mortality of freshwater fishes. Since the fingerlings require more oxygen and due to lack of oxygen they become more prone to infection. The pathological effect of *Lernaea* is greater in smaller fish because the attachment organs penetrate much deeper into the fish body, causing damage to internal organs (Dimovska and Stojanovski, 2022). This finding is similar to our research, where we concluded that *Lernaea* are particularly harmful to young fish due to their relatively large size and the method of attachment and feeding. The presence of *Lernaea* complicates consuming food and slowing down the growth of diseased fish (Ghittino, 1987).

The results also revealed that, the maximum prevalence of *Lernaea* parasitic in *Channa punctata* was recorded during summer and the minimum during winter; this could be related to the availability of intermediate hosts of these parasites at these seasons and increase the feeding activity in warm temperature. The maximum mean intensity and density or abundance of *Lernaea* was recorded in winter followed by spring, summer and autumn. Thus, it can be concluded that environmental factors influencing the seasonality of parasitic infection either directly or indirectly (Sinha, 2021).

Table 2: Haemato-biochemical parameters of non-infected and *Lernaea* infected *Channa punctata* collected from Sawan Nallaha

Haemato-biochemical Parameters	Spring Season		Summer Season		Autumn Season		Winter Season	
	Uninfected	Infected	Uninfected	Infected	Uninfected	Infected	Uninfected	Infected
RBC ($x 10^6/mm^3$)	2.18 ±0.11	1.85 ±0.12	2.23 ±0.21	1.78 ±0.18	2.48 ±0.18	1.80 ±0.15	2.50 ±0.11	1.83 ±0.17
TLC ($x 10^3/mm^3$)	1.79 ±2.11	2.11 ±1.11	1.81 ±1.21	2.21 ±1.12	1.74 ±1.46	2.18 ±1.12	1.69 ±1.16	1.89 ±1.18
Hb (%)	8.08 ±0.22	6.15 ±0.14	8.24 ±0.41	6.02 ±0.15	8.67 ±0.31	7.04 ±0.22	8.38 ±0.55	6.52 ±0.32
PCV (%)	28.44 ±0.22	22.02 ±0.16	23.21 ±1.23	19.11 ±0.44	22.52 ±0.28	18.05 ±0.33	22.42 ±0.41	18.45 ±0.18
Glucose (mg/dL)	65.55 ±0.65	70.02 ±0.53	57.75 ±0.25	62.85 ±0.51	56.90 ±0.76	64.52 ±0.73	52.70 ±0.81	57.14 ±0.55
Total Protein (mg/dL)	29.82 ±1.45	25.54 ±1.33	28.92 ±1.66	24.32 ±1.68	28.54 ±1.38	24.52 ±1.42	26.24 ±1.61	22.18 ±1.74
Triglyceride (mg/dL)	369.54 ±1.05	419.02 ±1.25	354.12 ±1.34	408.42 ±1.12	364.21 ±1.24	420.13 ±1.14	362.14 ±1.32	402.21 ±1.11

The results of the present investigation showed that *Lernaea* altered the haemato-biochemical parameters. Except TLC, all haematological parameters such as total RBC Count, haemoglobin (Hb%) and Packed Cell Volume (PCV%) were found to decreased in the *Lernaea* infected fishes as compared to uninfected *Channa punctata* (Table2). In the present investigation the decrease in RBC count, Hb%, and PCV% of *Lernaea* infected fishes may leads anaemia because parasite act as stressors. This decrease in RBC count, Hb% and PCV% were caused by parasite feeding on the host's blood (Parmar and Prakash, 2022) and the anaemia in infested fishes may be as a result of chronic liver inflammation which causes depression of erythrogenesis (Prakash and Verma, 2022). In the present study, the increase in total leucocytes count (TLC) in *Lernaea* infected fishes occurred as a pathological response since WBC plays most important role during infestation by stimulating the haemopoietic tissues or organs and the immune

system by producing antibodies and chemical substances working as defence against infestation (Prakash and Verma, 2022). In the present study significant increase in WBC in infected fishes was due to response of cellular immune system to parasitic infection. Anaemic conditions in *Lernaea* infected fishes, with a decrease in the number of erythrocytes and haematocrits in host blood due to feeding activity of parasite as well as failure of host osmoregulation due to skin lesions (Ali *et al*., 2010; Prakash and Verma, 2022).

In the present study the serum glucose level was increased in the *Lernaea* infected fish, *Channa punctata* revealed that parasites take glucose from the host and also during stress conditions fishes consume more energy to counteract the adverse effect of parasites. During stress conditions, epinephrine and cortisol activates increases that help in the breakdown of stored liver glycogen into glucose (Prakash and Verma, 2022). In the present study, the total serum protein was decreased in *Lernaea* infected fish, *Channa punctata*. Similar, depletion in serum protein content of *Channa striatus* infected with helminth parasite may be conversion of protein resources to release energy to withstand the wear and tear of the parasite (Upadhay *et al*., 2009; Yadav *et al.,* 2021). Triglycerides represent the major energy reserve in the fish (Verma and Prakash, 2020). In the present study the serum triglyceride level in *Lernaea* infected fish was increased hence lead to hypertriglyceridemic condition due to disfunction of liver. Because of the presence of this parasite, the physiological activities of the host fishes are upset and their development is hindered which causes economic loss to the fishery industry (Prakash and Verma, 2020).

CONCLUSION

Parasites are significant biotic component of an environment because of their impacts on the health of host fishes. The strength of a populace relies upon infectious prevention and keeping up with a sound connection between living life forms and their environment. There is a very high rate of stocking in intensive fish culture. Density of culturable fish in a small area, as well as their physiological and wellbeing status isn't good all of the time, consequently, a large number of people are at risk, with amazing circumstances for the spread of mass parasitic infections. In the majority of parasitic diseases, stressful situations are avoided and optimal water environment conditions are guaranteed, as is good health and physiological status, the fish may be able to bear the parasite invasion.

The result of present investigation can be concluded that the prevalence, mean intensity and density or abundance of infection of *Lernaea* were maximum in summer season followed by spring and winter season. Thus, it can be concluded that environmental factors influencing the seasonality of parasitic infection either directly or indirectly. At Present, India has second position in the world in total fish production, therefore if we are not aware to the mortality caused by parasitic infection, it may cause the serious loss in fish production. The Lernaeasis is one of the common fish diseases caused by the custodian ectoparasite, *Lernaea* sp. commonly known as anchor worm. In India it can cause mass mortality in freshwater fishes, if not, then also, morbidity due to loss of blood leads to weight loss and poor growth. Due to red or black patches on the body surface of the affected fishes the market value gets reduced and ultimately monetary losses to the fish farmers.

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