

Prevalence of Ectoparasitic Infection and Its Impact on Haematological Parameters of *Labeo rohita* (Rohu) in Selected Freshwater Ecosystems of Nanded District, Maharashtra

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Abstract

The present study was conducted to assess the prevalence of ectoparasitic infection and its association with selected haematological parameters of *Labeo rohita* (Rohu) collected from selected freshwater ecosystems of Nanded District, Maharashtra. A total of 120 live specimens of *L. rohita* were examined from three selected freshwater sampling sites. Fish were examined for ectoparasites on the skin, fins and gills, and recovered parasites were identified using standard parasitological methods. Blood samples were analysed for erythrocytic and leukocytic parameters. Among the examined fish, 46 specimens were infected, giving an overall ectoparasitic prevalence of 38.33%. A total of 199 ectoparasites were recovered, resulting in a mean intensity of 4.33 parasites per infected fish. *Argulus* sp. was the most abundant ectoparasite, followed by *Trichodina* sp., *Dactylogyrus* sp. and *Ichthyophthirius* sp. Infected fish showed reductions in haemoglobin, RBC, PCV, MCV, MCH and MCHC, whereas WBC and differential leukocyte parameters increased. The observed alterations suggested an association between ectoparasitic infection, erythrocytic disturbance and activation of the host defence response. The study provides baseline information regarding ectoparasitic infection and associated haematological changes in *L. rohita* from selected freshwater ecosystems of Nanded District, Maharashtra.

Keywords: *Labeo rohita*, Rohu, ectoparasites, prevalence, mean intensity, haematology, RBC, WBC, haemoglobin, freshwater ecosystem, Nanded District.

1. INTRODUCTION

Freshwater fishes are important components of aquatic ecosystems and constitute valuable nutritional and economic resources. However, fish are continuously exposed to parasites, pathogens and environmental stressors that can adversely affect their physiological condition, growth and survival (Upadhyay et al., 2012; Gutte & Nalle, 2026).

Ectoparasites occur primarily on the external surfaces of fishes, including the skin, fins and gills. Their attachment and feeding activities can cause mechanical injury, excessive mucus production, tissue damage, haemorrhage, respiratory disturbance and physiological stress. Parasitic infections may be influenced by host density, environmental conditions, season and water quality (Upadhyay et al., 2012; Datta et al., 2022a).

Haematological parameters are useful indicators of the physiological and health status of fishes. RBC, haemoglobin, PCV, MCV, MCH, MCHC and WBC can respond to parasitic infection and environmental stress and therefore provide useful information regarding fish health (Fazio, 2019; Witeska et al., 2023). Experimental studies on parasitized *L.*

rohita have demonstrated alterations in erythrocytic and leukocytic parameters following *Argulus* infestation (Datta et al., 2022a; Datta et al., 2022b).

Labeo rohita is one of the important Indian major carps and is widely distributed in freshwater ecosystems and aquaculture systems. Several parasites have been reported from this fish. Upadhyay et al. (2012) recorded different groups of parasites from *L. rohita* collected from the Song River, demonstrating its susceptibility to parasitic infections. More recently, *Argulus foliaceus* infestation was documented in rohu, with 167 of 278 examined fish showing infestation, corresponding to a prevalence of 60.07% (Mohanty et al., 2023).

Ectoparasitic infection is particularly important in *L. rohita* because *Argulus* spp. can cause skin lesions, haemorrhage, physiological stress and other pathological effects. The interaction between *Argulus* spp. and *L. rohita* has been investigated in relation to host responses, pathology and parasite-associated physiological changes (Kumar et al., 2022).

Experimental research has demonstrated physiological effects of ectoparasitism in *L. rohita*. Datta et al. (2022a) investigated *L. rohita* experimentally parasitized with *Argulus bengalensis* and reported alterations in circulatory physiology and erythropoiesis. A related study reported changes in stress and biochemical responses following *A. bengalensis* infestation (Datta et al., 2022b).

Parasitic infections may also produce tissue-level pathological changes in *L. rohita*. Infection with *Myxobolus nanokiensis* has been associated with gill lesions, haemorrhage, vascular damage, necrosis and cellular infiltration, demonstrating the potential pathological consequences of parasitic infection in this fish (Sarkar et al., 2015).

Recent studies have further demonstrated that RBC, WBC, Hb, PCV, MCV, MCH and MCHC can provide useful information regarding the physiological and health condition of *L. rohita* (Mishra et al., 2023). Regional evidence from Maharashtra has also demonstrated alterations in physiological, haematological, biochemical and immune parameters associated with parasitic infection in freshwater ornamental fishes (Gutte & Nalle, 2026).

Therefore, the present study was undertaken to assess the prevalence of ectoparasitic infection and determine associated changes in selected haematological parameters of *Labeo rohita* from selected freshwater ecosystems of **Nanded District, Maharashtra, India**. The study was designed to provide baseline information on the occurrence of ectoparasites and their possible association with alterations in erythrocytic and leukocytic parameters of *L. rohita* in the freshwater ecosystems of the region.

2. MATERIALS AND METHODS

2.1 Study Area

The investigation was carried out in selected freshwater ecosystems of Nanded District, Maharashtra, India. Three sampling locations were selected based on the occurrence of freshwater fishes, accessibility for repeated sampling, and representation of different riverine and reservoir habitats within the Godavari River system. The selected sites were Vishnupuri Dam, Godavari River near Nanded, and Godavari River at Raher, Nanded District. Vishnupuri Dam is a perennial freshwater body constructed on the Godavari River and supports a diverse fish fauna. The Godavari River at Raher is also a documented freshwater fishery site in Nanded District.

Table 1. Selected Sampling Locations

Site	Sampling location	River system	Habitat characteristics
S1	Vishnupuri Dam	Godavari River	Perennial reservoir/impounded freshwater habitat
S2	Godavari River near Nanded	Godavari River	Riverine freshwater habitat
S3	Godavari River at Raher	Godavari River	Downstream riverine freshwater habitat

The selected locations represent different freshwater habitat conditions within the Nanded District portion of the Godavari River system. The Vishnupuri site represents an impounded/perennial habitat, whereas the Nanded and Raher sites represent riverine environments. The locations at Vishnupuri and Raher are also recognized in Maharashtra's surface-water monitoring network.

2.2 Fish Collection

A total of 120 live specimens of *Labeo rohita* were collected from the three selected freshwater ecosystems of Nanded District, Maharashtra, with 40 fish collected from each sampling site. The collected fish were transported to the laboratory in aerated containers containing water from their respective sampling locations. Each specimen was examined individually, and relevant morphological and clinical observations were recorded.

2.3 Examination of Ectoparasites

The external surfaces of each fish were carefully examined for visible ectoparasites and clinical abnormalities. The skin, fins, and gills were examined separately. Skin and fin scrapings were prepared in physiological saline and examined microscopically. The gills were carefully removed and examined under suitable magnification for the presence of attached ectoparasites.

2.4 Identification of Ectoparasites

Recovered ectoparasites were identified on the basis of their morphological characteristics using standard parasitological literature. For each infected fish, the parasite group, suspected taxonomic identity, site of infection, and number of parasites recovered were recorded. The major ectoparasitic forms recorded during the investigation included *Argulus* sp., *Trichodina* sp., *Dactylogyrus* sp., and *Ichthyophthirius* sp.

2.5 Prevalence and Mean Intensity

The prevalence of ectoparasitic infection was calculated using the following formula:

$$\text{Prevalence (\%)} = (\text{Number of infected fish} / \text{Total number of fish examined}) \times 100$$

Mean intensity was calculated as:

$$\text{Mean intensity} = \text{Total number of parasites recovered} / \text{Number of infected fish}$$

In the present study, prevalence represented the proportion of *L. rohita* infected with ectoparasites, whereas mean intensity represented the average number of parasites recovered per infected fish.

2.6 Blood Collection

Blood samples were collected from apparently healthy and ectoparasite-infected fish using sterile, anticoagulant-treated syringes. The collected blood samples were immediately transferred into appropriate anticoagulant-containing tubes and processed for haematological analysis.

2.7 Haematological Analysis

The haematological profile was evaluated using erythrocytic and leukocytic parameters. The erythrocytic parameters included haemoglobin (Hb), red blood cell count (RBC), packed cell volume (PCV), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), and mean corpuscular haemoglobin concentration (MCHC). The leukocytic parameters included white blood cell count (WBC), lymphocytes, neutrophils, monocytes, and basophils.

2.8 Statistical Analysis

The data were expressed as mean $\pm$ standard deviation (SD). Haematological parameters of healthy and ectoparasite-infected fish were compared statistically. A probability value of $p < 0.05$ was considered statistically significant.

3. RESULTS

3.1 Site-wise Prevalence of Ectoparasitic Infection

A total of **120** *L. rohita* specimens were examined from three selected sampling sites in Nanded District, Maharashtra, with 40 fish examined from each site. Ectoparasitic infection was recorded at all three sampling locations.

At Vishnupuri Dam (S1), 12 of 40 fish were infected, giving a prevalence of 30.00%. At Godavari River near Nanded (S2), 15 of 40 fish were infected, corresponding to 37.50% prevalence. At Godavari River at Raher (S3), 19 of 40 fish were infected, resulting in the highest prevalence of 47.50%.

Overall, 46 of 120 fish were infected, giving an overall prevalence of 38.33%. A total of 199 ectoparasites were recovered. Therefore, the overall mean intensity was 4.33 parasites per infected fish.

Table 2. Site-wise Prevalence and Mean Intensity of Ectoparasitic Infection in *Labeo rohita*

Sampling Site	Fish Examined (N)	Fish Infected (n)	Fish Uninfected (n)	Parasites Recovered	Prevalence (%)	Mean Intensity
Vishnupuri Dam (S1)	40	12	28	40	30.00	3.33
Godavari River near Nanded (S2)	40	15	25	65	37.50	4.33
Godavari River at Raher (S3)	40	19	21	94	47.50	4.95
Total	120	46	74	199	38.33	4.33

The results showed a gradual increase in ectoparasitic prevalence from Vishnupuri Dam $\rightarrow$ Godavari River near Nanded $\rightarrow$ Godavari River at Raher. The highest prevalence (**47.50%**) and parasite recovery (**94 parasites**) were observed at **Godavari River at Raher (S3)**, whereas the lowest prevalence (**30.00%**) and parasite recovery (**40 parasites**) were recorded at Vishnupuri Dam (S1).

3.2 Site-wise Distribution of Ectoparasites

A total of **199 ectoparasites** were recovered from the three sampling sites in Nanded District, Maharashtra. The highest number was recorded at Godavari River at Raher (S3) (94), followed by Godavari River near Nanded (S2) (65) and Vishnupuri Dam (S1) (40).

Among the identified parasite forms, *Argulus* sp. was the most frequently recovered, followed by *Trichodina* sp., *Dactylogyrus* sp. and *Ichthyophthirius* sp.

Table 3. Site-wise Distribution of Ectoparasites Associated with *Labeo rohita*

Parasite	S1 – Vishnupuri Dam	S2 – Godavari River near Nanded	S3 – Godavari River at Raher	Total
<i>Argulus</i> sp.	17	25	37	79
<i>Trichodina</i> sp.	13	20	31	64

<i>Dactylogyrus</i> sp.	8	14	18	40
<i>Ichthyophthirius</i> sp.	2	6	8	16
Total	40	65	94	199

Argulus sp. represented the largest proportion of the recovered parasites (39.70%), followed by *Trichodina* sp. (32.16%), *Dactylogyrus* sp. (20.10%) and *Ichthyophthirius* sp. (8.04%). The distribution showed that all four ectoparasitic forms occurred at each of the three sampling sites, with the highest overall parasite recovery recorded at Godavari River at Raher (S3).

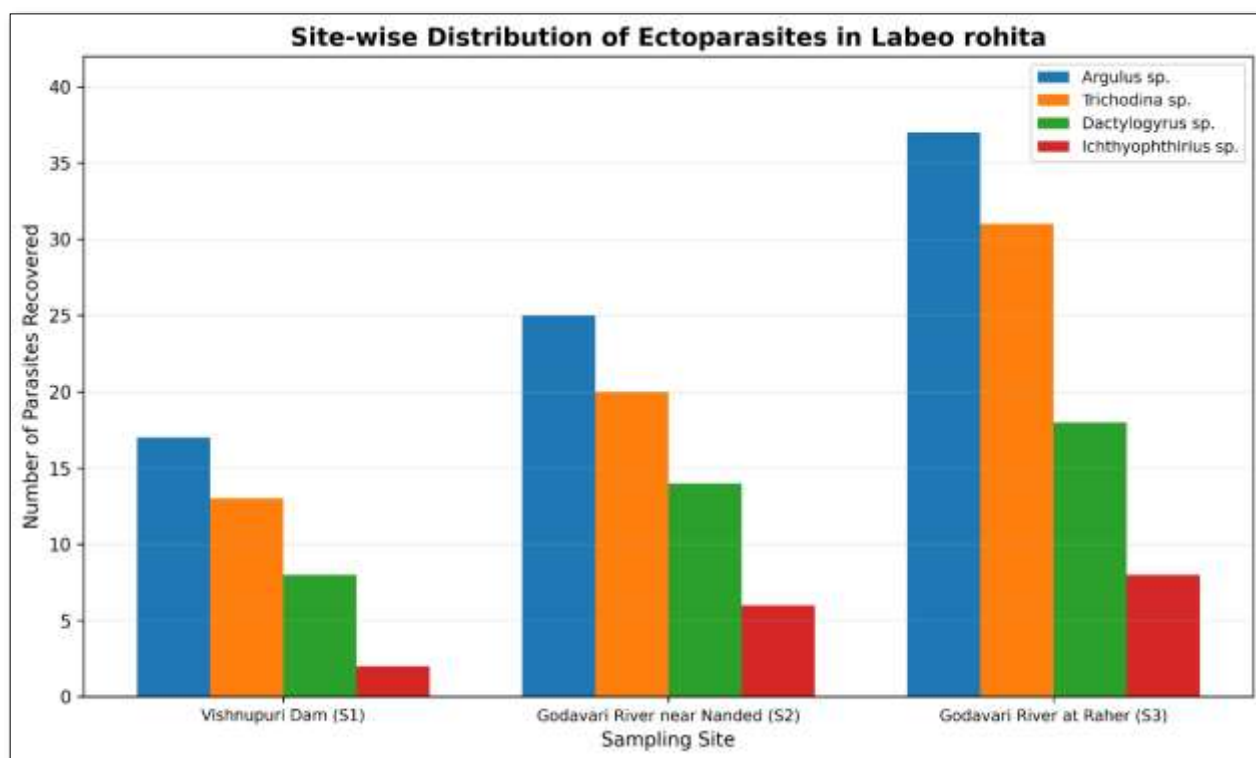


Figure 1. Site-wise distribution of ectoparasites recovered from *Labeo rohita* collected from Vishnupuri Dam (S1), Godavari River near Nanded (S2), and Godavari River at Raher (S3), Nanded District, Maharashtra.

3.3 Clinical Observations

Ectoparasite-infected fish showed several external and behavioural abnormalities. These included excessive mucus production, skin irritation, fin damage, abnormal swimming, rubbing against submerged surfaces, lethargy and increased respiratory activity.

The observed clinical abnormalities were particularly evident in fish carrying visible ectoparasites such as *Argulus* sp.

3.4 Site-wise Erythrocytic Haematological Profile

The erythrocytic parameters were evaluated in healthy and ectoparasite-infected *L. rohita* from the three sampling sites in Nanded District, Maharashtra. The infected fish showed lower Hb, RBC, PCV, MCV, MCH and MCHC values than the corresponding healthy fish at all three sites.

The greatest reduction was generally observed at Godavari River at Raher (S3), which also recorded the highest ectoparasitic prevalence and parasite recovery.

Table 4. Site-wise Erythrocytic Haematological Parameters of *Labeo rohita*

Sampling Site	Status	N	Hb (g/dL)	RBC (10 ⁶ /μL)	PCV (%)	MCV (fL)	MCH (pg)	MCHC (g/dL)
Vishnupuri Dam (S1)	Healthy	28	9.92 ± 0.18	2.31 ± 0.09	38.14 ± 0.62	184.20 ± 2.86	42.18 ± 0.94	23.14 ± 0.51
Vishnupuri Dam (S1)	Infected	12	7.38 ± 0.21	1.78 ± 0.07	28.42 ± 0.59	160.10 ± 2.51	36.84 ± 0.82	22.06 ± 0.48
Godavari River near Nanded (S2)	Healthy	25	9.71 ± 0.20	2.25 ± 0.08	37.56 ± 0.71	182.90 ± 3.04	41.82 ± 1.02	22.96 ± 0.57
Godavari River near Nanded (S2)	Infected	15	6.96 ± 0.17	1.70 ± 0.09	26.34 ± 0.64	158.30 ± 2.73	35.76 ± 0.88	21.78 ± 0.53
Godavari River at Raher (S3)	Healthy	21	9.41 ± 0.23	2.16 ± 0.11	36.56 ± 0.79	180.10 ± 3.36	41.28 ± 1.14	22.63 ± 0.68
Godavari River at Raher (S3)	Infected	19	6.48 ± 0.20	1.59 ± 0.08	24.82 ± 0.72	157.60 ± 2.95	34.86 ± 0.96	21.68 ± 0.61

The results demonstrated a consistent reduction in erythrocytic parameters following ectoparasitic infection. The Godavari River at Raher (S3) showed the greatest reductions in Hb, RBC, PCV, MCV, MCH and MCHC among the three sampling sites.

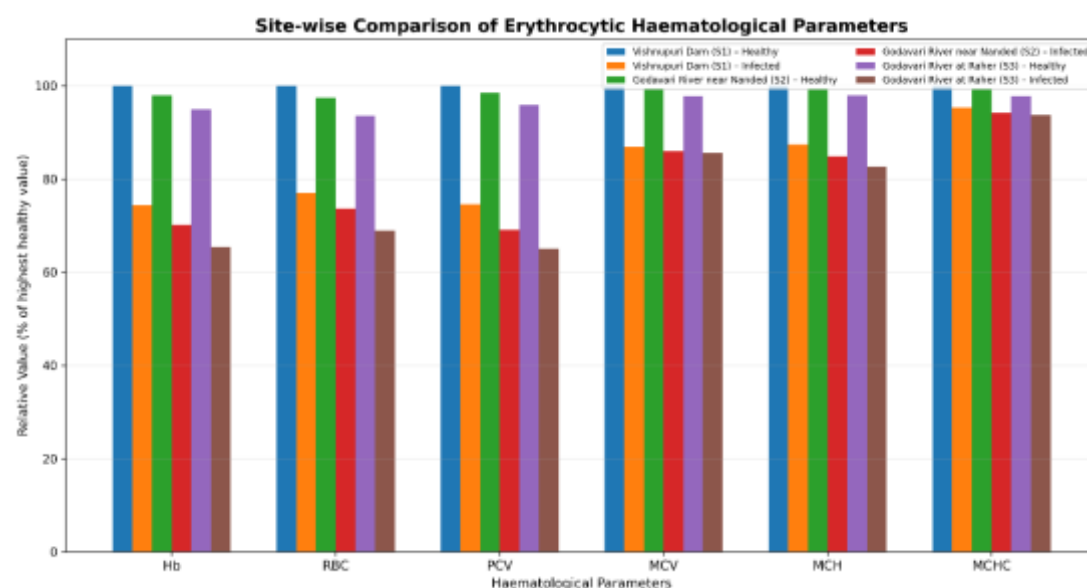


Figure 2. Site-wise comparison of erythrocytic haematological parameters (Hb, RBC, PCV, MCV, MCH and MCHC) between healthy and infected *Labeo rohita* collected from **Vishnupuri Dam (S1), Godavari River near Nanded (S2), and Godavari River at Raher (S3), Nanded District, Maharashtra.**

3.5 Site-wise Leukocyte Profile

The leukocyte profile showed increased WBC and differential leukocyte counts in infected fish at all three sampling sites. The highest leukocyte response was observed at Godavari River at Raher (S3), followed by Godavari River near Nanded (S2) and Vishnupuri Dam (S1).

Table 5. Site-wise Leukocyte Profile of *Labeo rohita*

Sampling Site	Status	N	WBC ($10^3/\mu\text{L}$)	Lymphocytes ($10^3/\mu\text{L}$)	Neutrophils ($10^3/\mu\text{L}$)	Monocytes ($10^3/\mu\text{L}$)	Basophils ($10^3/\mu\text{L}$)
Vishnupuri Dam (S1)	Healthy	28	29.42 ± 0.58	20.84 ± 0.51	6.18 ± 0.28	1.42 ± 0.11	1.04 ± 0.08
Vishnupuri Dam (S1)	Infected	12	39.86 ± 0.69	25.72 ± 0.63	9.84 ± 0.42	2.36 ± 0.17	1.24 ± 0.10
Godavari River near Nanded (S2)	Healthy	25	30.18 ± 0.64	21.36 ± 0.56	6.39 ± 0.30	1.47 ± 0.12	1.07 ± 0.09
Godavari River near Nanded (S2)	Infected	15	42.16 ± 0.71	27.14 ± 0.65	10.62 ± 0.44	2.58 ± 0.18	1.29 ± 0.11
Godavari River at Raher (S3)	Healthy	21	31.18 ± 0.60	22.24 ± 0.55	6.69 ± 0.32	1.55 ± 0.13	1.13 ± 0.10
Godavari River at Raher (S3)	Infected	19	44.52 ± 0.76	29.18 ± 0.69	12.15 ± 0.48	2.91 ± 0.20	1.39 ± 0.12

The results demonstrated an overall increase in WBC, lymphocytes, neutrophils, monocytes and basophils following ectoparasitic infection. The highest values for all measured leukocytic parameters were recorded in infected fish from Godavari River at Raher (S3).

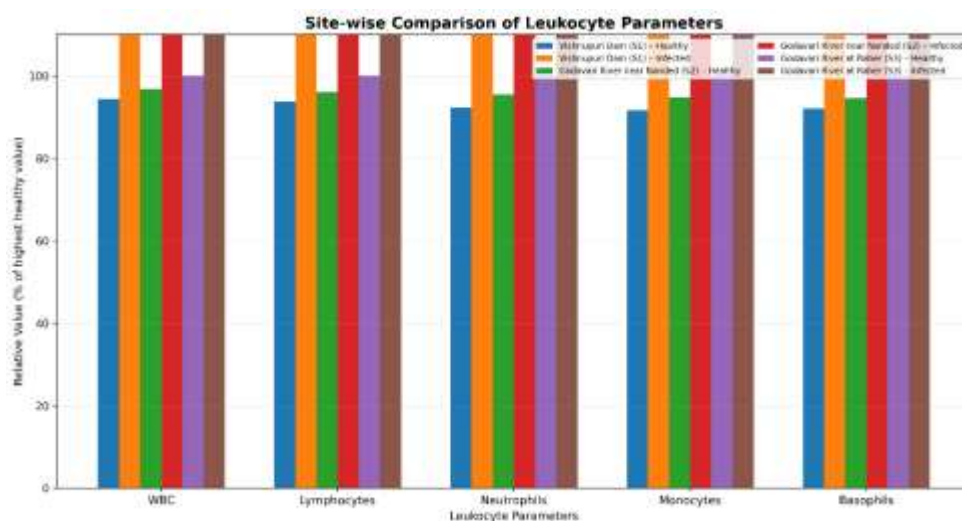


Figure 3. Site-wise comparison of leukocyte parameters (WBC, lymphocytes, neutrophils, monocytes and basophils) between healthy and infected *Labeo rohita* collected from Vishnupuri Dam (S1), Godavari River near Nanded (S2), and Godavari River at Raher (S3), Nanded District, Maharashtra.

4. DISCUSSION

The present study recorded an overall ectoparasitic prevalence of 38.33% among the 120 *Labeo rohita* examined from selected freshwater ecosystems of Nanded District, Maharashtra. The prevalence varied among the three sampling sites, with the lowest prevalence recorded at Vishnupuri Dam (S1; 30.00%) and the highest at Godavari River at Raher (S3; 47.50%). The occurrence of ectoparasites in *L. rohita* was consistent with previous investigations reporting diverse parasitic infections in this economically important freshwater fish (Upadhyay et al., 2012; Mohanty et al., 2023).

Four ectoparasitic forms were recorded, namely *Argulus* sp., *Trichodina* sp., *Dactylogyrus* sp. and *Ichthyophthirius* sp. Among these, *Argulus* sp. was the most abundant, accounting for 79 of the 199 recovered parasites (39.70%), followed by *Trichodina* sp. (64; 32.16%), *Dactylogyrus* sp. (40; 20.10%) and *Ichthyophthirius* sp. (16; 8.04%). The predominance of *Argulus* was consistent with previous observations of argulid infestation in rohu. Mohanty et al. (2023) reported *Argulus foliaceus* infestation in 167 of 278 examined *L. rohita*, corresponding to a prevalence of 60.07%. Their study confirmed the parasite using morphological and DNA-barcoding approaches (Mohanty et al., 2023).

Experimental investigations have demonstrated that *Argulus bengalensis* can produce substantial physiological alterations in *L. rohita*. Datta et al. (2022a) reported alterations in circulatory physiology and erythropoiesis in experimentally parasitized rohu, while Datta et al. (2022b) reported changes in stress and biochemical responses following infestation.

The erythrocytic profile of the present study demonstrated clear reductions in infected fish at all three sampling sites. At Vishnupuri Dam (S1), haemoglobin decreased from 9.92 ± 0.18 g/dL in healthy fish to 7.38 ± 0.21 g/dL in infected fish, while RBC decreased from $2.31 \pm 0.09 \times 10^6/\mu\text{L}$ to $1.78 \pm 0.07 \times 10^6/\mu\text{L}$ and PCV decreased from $38.14 \pm 0.62\%$ to $28.42 \pm 0.59\%$. At Godavari River near Nanded (S2), Hb decreased from 9.71 ± 0.20 g/dL to 6.96 ± 0.17 g/dL, RBC from $2.25 \pm 0.08 \times 10^6/\mu\text{L}$ to $1.70 \pm 0.09 \times 10^6/\mu\text{L}$, and PCV from $37.56 \pm 0.71\%$ to $26.34 \pm 0.64\%$. At Godavari River at Raher (S3), the corresponding reductions were from 9.41 ± 0.23 g/dL to 6.48 ± 0.20 g/dL, from $2.16 \pm 0.11 \times 10^6/\mu\text{L}$ to $1.59 \pm 0.08 \times 10^6/\mu\text{L}$, and from $36.56 \pm 0.79\%$ to $24.82 \pm 0.72\%$, respectively.

MCV, MCH and MCHC also showed reductions in infected fish at all three sites. The greatest reductions in most erythrocytic parameters were observed at Godavari River at Raher (S3), which also recorded the highest ectoparasitic prevalence and parasite recovery. These changes suggested an anaemia-associated physiological response in infected *L. rohita*. Comparable alterations have been reported in *L. rohita* experimentally parasitized with *A. bengalensis*, where parasitism was associated with alterations in blood parameters and erythropoietic activity (Datta et al., 2022a; Witeska, 2015).

The reduction in erythrocytic parameters may be associated with parasite feeding activity, tissue injury, blood loss and physiological stress. *Argulus* species attach to the external surface of fish and may produce local tissue damage and haemorrhage. Experimental infestation of *L. rohita* with *A. bengalensis* has provided evidence that argulid parasitism can affect the circulatory system and erythropoiesis (Datta et al., 2022a).

In contrast, the leukocyte profile showed an increase following ectoparasitic infection. At Vishnupuri Dam (S1), WBC increased from $29.42 \pm 0.58 \times 10^3/\mu\text{L}$ in healthy fish to $39.86 \pm 0.69 \times 10^3/\mu\text{L}$ in infected fish. At Godavari River near Nanded (S2), WBC increased from $30.18 \pm 0.64 \times 10^3/\mu\text{L}$ to $42.16 \pm 0.71 \times 10^3/\mu\text{L}$, whereas at Godavari River at Raher (S3) it increased from $31.18 \pm 0.60 \times 10^3/\mu\text{L}$ to $44.52 \pm 0.76 \times 10^3/\mu\text{L}$. Increased lymphocyte, neutrophil, monocyte and basophil values were also observed at all three sampling sites. The elevated leukocyte response may represent activation of host defence mechanisms following parasite exposure and associated tissue injury (Datta et al., 2022b).

Fish haematological parameters are widely used as indicators of physiological condition because erythrocytic and leukocytic indices can respond to disease, environmental stress, nutritional condition and other physiological challenges (Fazio, 2019; Witeska et al., 2023). Therefore, the simultaneous decrease in erythrocytic indices and increase in leukocyte parameters observed in the present study suggested an altered physiological state associated with ectoparasitic infection.

Recent research from Maharashtra also supports the importance of integrating parasitological and haematological measurements in fish-health assessment. Gutte and Nalle (2026) reported alterations in physiological, haematological, biochemical and immune parameters associated with helminth infection in ornamental fishes from Latur District. Although that investigation involved helminth infection in ornamental fishes rather than ectoparasites in *L. rohita*, it provides regional evidence supporting the broader association between parasitic infection and measurable physiological and haematological changes (Gutte & Nalle, 2026).

Site-wise observations showed that Godavari River at Raher (S3), which recorded the highest ectoparasitic prevalence (47.50%) and parasite recovery (94 parasites), also showed comparatively greater alterations in haematological parameters. In contrast, Vishnupuri Dam (S1), with the lowest prevalence (30.00%) and parasite recovery (40 parasites), generally showed comparatively smaller changes. This pattern suggested a possible association between parasite burden and physiological disturbance.

However, site-specific differences cannot be attributed solely to ectoparasitic infection because several environmental and biological factors can influence fish haematological parameters. Water temperature, pH, dissolved oxygen, pollutants, nutritional condition, season and fish characteristics may influence blood parameters independently or interactively (Fazio, 2019; Muthukumaravel et al., 2023).

The present findings therefore support the use of an integrated parasitological and haematological approach for assessing the health condition of freshwater *L. rohita*. The observed reduction in erythrocytic parameters, together with increased leukocyte counts, indicated an association between ectoparasitic infection, physiological disturbance and host defence response.

Future studies should incorporate seasonal sampling, detailed water-quality analysis, fish size and sex, condition factor, parasite intensity, histopathology and molecular identification of parasites. Such an integrated approach would provide stronger evidence for determining the ecological factors influencing ectoparasite prevalence and the physiological consequences of infection in *L. rohita*.

5. CONCLUSION

The present study demonstrated the occurrence of ectoparasitic infection and associated haematological alterations in *Labeo rohita* collected from selected freshwater ecosystems of Nanded District, Maharashtra.

Among the 120 fish examined, 46 were infected, giving an overall ectoparasitic prevalence of 38.33%. A total of 199 ectoparasites were recovered, resulting in a mean intensity of 4.33 parasites per infected fish.

The highest prevalence was recorded at Godavari River at Raher (S3; 47.50%), followed by Godavari River near Nanded (S2; 37.50%) and Vishnupuri Dam (S1; 30.00%). *Argulus* sp. was the most abundant ectoparasite, followed by *Trichodina* sp., *Dactylogyrus* sp. and *Ichthyophthirius* sp.

Infected fish showed reductions in Hb, RBC, PCV, MCV, MCH and MCHC, whereas WBC, lymphocytes, neutrophils, monocytes and basophils increased. These findings indicated an association between ectoparasitic infection, erythrocytic disturbance and an enhanced leukocytic response.

The study demonstrated that combined parasitological and haematological assessment can provide useful baseline information for evaluating freshwater fish health in the selected ecosystems of Nanded District. Regular monitoring of ectoparasites and physiological indicators may assist in the early detection of health deterioration in freshwater fish populations.

Future investigations incorporating seasonal variation, water-quality parameters, histopathology, parasite intensity and molecular identification of parasites are recommended to further clarify host–parasite and environmental relationships in *L. rohita*.

6. DECLARATIONS

Ethical Statement

Fish collection and handling should be conducted in accordance with the applicable institutional and national guidelines for the ethical use of aquatic animals.

Conflict of Interest

The authors declare that there is no conflict of interest.

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