

Comparative assessment of parasite infections in marine food fishes

T. Aravinda, K.R. Ramudu, B.S. Haragi, T. Hussain, M.J. Lincy, Sagar, C. Kalidas

¹Department of Studies in Marine Biology, Karnatak University Post Graduate Centre, ²Karwar Regional Station of ICAR-Central Fisheries Research Institute, Karwar, Karnataka.

Corresponding Author: *raghu.kurva77@icar.org.in

Journal of Livestock Science (ISSN online 2277-6214) 17: 862-869

Received on 11/2/26; Accepted on 4/10/26; Published on 6/10/26

doi. 10.33259/JLivestSci.2026.862-869

Abstract

This study presents a comparative analysis of parasitic infections in selected commercially important edible marine fish collected from coastal landing centres, viz., Ravindranath Tagore Beach and Majali. Parasitic infestations are the primary cause of infection or infestation on host; it leads to badly affect fish growth and its normal functions of the body, often consequential in significant profitable losses due to less market value. Two main landing centres such as Ravindranath Tagore and Majali were selected to assess the prevalence, intensity of the parasites in important marine food fishes. A total of 1,006 fish samples were examined and 868 were found infected with 593 parasites, indicative of five major groups such as Isopods (290), *Dactylogyrus* spp. (176), *Caligus* spp. (45), Nematodes (70), and other helminth parasites (12). Among 868 infected fish, the maximum parasite loads were noted in *Rastrelliger kanagurta*, *Mugil cephalus*, and *Terapon jarbua*. Most copepods family belongs to the Caligidae, while isopods were from Cymothoidae. Isopods and *Dactylogyrus* spp. were common across species, whereas *Caligus* spp. and helminth developmental stages were mainly found in *Mugil cephalus*, and nematodes were exclusive to *Tylosurus crocodilus*. It's been observed that the parasites mainly settled in gill lamellae, operculum, surfaces of the body, fins, and gut, attaching via hook or needle-like appendages. Histopathological investigation revealed epithelial hyperplasia, excessive mucus secretion, lamellar fusion, and necrosis, it may leading to less oxygen uptake and systemic stress. The major findings highlight the significant prevalence, intensity, and pathological impacts of parasites on the host. This needs the continuous monitoring and for the effective management strategies to avoid secondary infections by the bacteria, virus and fungus in marine food fisheries.

Key words: Marine food fishes, Parasites, PFI, Intensity, Severity, Histopathology.

Introduction

Marine food fish are crucial for the global food security, human nutrition, and the financial benefit for the coastal communities. They provide high-quality proteins, omega-3 fatty acids, essential vitamins, and trace elements. Millions of people depend on them for their livelihoods through fisheries and aquaculture (FAO 2022; Rifat et al. 2023). However, parasitic infections gradually increasing and threatening the sustainability of these resources in both wild and cultured fish populations (Mustafa et al. 2024).

Parasitic infestations/infections include wide range of organisms such as protozoans, monogeneans, trematodes, cestodes, nematodes, and parasitic crustaceans (Imran et al. 2021). These parasites may inhabit external surfaces such as skin, gills, and fins, as well as internal organs, and many possess complex life cycles that complicate control measures (Woo 2006). Moreover, environmental stressors such as temperature fluctuations, pollution, and excess numbers or high stocking densities can increase infections by weakening host immune defence system (Martyniuk et al. 2025).

Parasitic infections bring major tissue damage, including physical damage/irritation, hemorrhage, necrosis, granuloma formation, and organ dysfunction due to the toxins released by the parasites through secretory products (Manoharan & Srinivasan 2017). All these directly effects on the growth rates, feed efficiency, and increase mortality of the fishes, particularly in aquaculture systems (Roberts 2012). Furthermore, zoonotic parasites such as *Anisakis*, *Diphyllbothrium*, and *Clonorchis* represent significant public health concerns, particularly in light of the increasing global consumption of raw or inadequately cooked fish (Carlos et al. 2011; Chai et al. 2005).

Despite their significance, comprehensive pathological investigations of parasites affecting marine food fish are still scarce, especially in regions with high biodiversity and strong reliance on fisheries. The majority of existing studies emphasize taxonomy and prevalence, whereas in-depth histopathological analyses that clarify host-parasite interactions and mechanisms of disease development remain relatively limited (Imran et al. 2021; Buchmann 2012).

Most of the marine parasites are introduced from wild fish populations. These are transferred/affecting marine food fishes and finally end result in substantial economic losses to fishermen and farmers in both marine aquaculture systems and capture fisheries. Therefore, the present study was undertaken with two primary objectives: to isolate and identify parasitic species and to evaluate their pathological effects on fish tissues along the Karwar coast. By combining morphotaxonomic identification with histological analysis, this study aims to document parasite-induced tissue lesions and host immune responses, thereby contributing to improved aquaculture health management and enhanced seafood safety.

Materials and Methodology

Sampling areas: Fish samples were collected from coastal sites along the Karwar coast, including Ravindranath Tagore Beach (14°48'40" N, 74°07'31" E) and Majali (14°48'40" N, 74°05'57" E), India. The study on the marine food fishes was carried out over a three-month period from April to June 2025.

Collection of Samples: The fish samples were collected on a regular basis once in week. In each sampling an average of twenty fishes of each species collected according to the fish catch, the catch includes *Thryssa mystax*, *Mugil cephalus*, *Rastrelliger kanagurta*, *Terapon jarbua*, and *Tylosurus crocodiles* and they were collected in moribund condition. The fishes were brought to the laboratory and the total length body weight of fishes were taken. The vital organs like skin, intestine, kidney and gills were examined for the presence of different parasites (Ramudu et al. 2026). External structures (gills, fins, scales, operculum, mucus) were examined under a microscope after careful removal and transfer to saline. Each fin and gill arch was inspected individually. Scales were scraped to detect ectoparasites. This ensured thorough and accurate parasite identification.

Fixation and Preservation: External parasites were removed by gently scraping the mucus layer with a scalpel, mixed with 0.9% saline, mounted on slides, and examined under microscope (Carl Zeiss MicroImaging GmbH, Axio, Germany). For gill parasites, especially monogeneans, gill arches were excised, scraped in saline, and parasites were mounted for observation.

Determination of Parasitic Frequency Index (PFI): PFI was calculated as the percentage of hosts infected with a specific parasite species relative to the total number of hosts examined in the study area, following the methods described by Ramudu and Dash (2013, 2016) and Ramudu and Rathod (2024).

Determination of Severity of Infection/Infestation: In this study, the severity of infection was determined following the generalized classification scheme proposed by Ramudu and Dash (2013, 2016) and Lightner (1993).

Histopathology: Infested/parasitized tissues were fixed in 10% Neutral Buffered Formalin (NBF) for 24 h, followed by transfer to fresh 10% NBF for an additional 1 h, and subsequently histopathological processing was carried out according to the protocol described by Roberts (2012). Prepared slides were examined and colour photomicrographs at different magnifications were taken using a binocular phase-contrast microscope equipped with an integrated digital camera (Carl Zeiss MicroImaging GmbH, Axio, Germany), to document the observed pathological alterations.

Results

A total of 1,006 specimens from five important marine food fish which includes *Thryssa mystax*, *Mugil cephalus*, *Rastrelliger kanagurta*, *Terapon jarbua*, and *Tylosurus crocodilus* were collected from Ravindranath Tagore landing centre and Majali in the Karnataka coast over a three-month period (April to June 2025). Among these, 868 fish (86.3%) were infected, with 593 parasites identified across five groups: Isopods (n=290), *Dactylogyrus* spp. (n=176), *Caligus* spp. (n=45), Nematodes (n=70), and helminth larvae (n=12).

Isopods (family Cymothoidae) and *Dactylogyrus* spp. were widespread across all host species, commonly attaching to gills and skin. *Caligus* spp. and helminth developmental stages showed strong host specificity, occurring predominantly in *M. Cephalus* (Fig.13), while nematodes were exclusively found in *T. crocodilus*. The highest parasite loads were recorded in *R. kanagurta*, *M. cephalus*, and *T. Jarbua*. In the current study parasites were observed on gills, followed by skin, fins, and gut, this indicates site-specific preferences by the parasites for their feeding.

Mean Intensity: Parasites per infected fish varied across hosts. *M. cephalus* showed the highest Isopod intensity (1.50) in the month of May, while *T. jarbua* had the lowest (0.50) in the month of, April, (Fig.12). *T. jarbua* also had the peak intensity (1.00) in the month of June with *Dactylogyrus* spp. flukes. *Caligus* spp. in *M. cephalus* exhibited moderate intensity (0.67) in the month June, *T. crocodilus* recorded the highest intensity with Nematodes (2.50) in April month, this indicating severe infections in affected individual populations (Fig.1 & 2).

Severity: As per our observations severity, always recorded as 0.5 throughout the study, it indicates a uniform impact on host per parasite, likely a standardized measure in the study. This consistency indicates that variations in the impact of infection are primarily influenced by PFI (%) and mean intensity, rather than by differences in severity scores.

Prevalence / Parasitic Frequency Index (PFI %): The prevalence of the parasites was changing with different species and season. *T. jarbua* showed the highest Isopod PFI (90.91%, June), indicating high susceptibility, followed by *R. kanagurta* (69.23%, May). Lower Isopod PFI was recorded in *T. mystax* (27.78%, June) and *T. crocodilus* (35.71%, April). *Dactylogyrus* spp. infected all species, peaking in *T. jarbua* (46%, May). *Caligus* spp. were exclusive to *M. cephalus*, with PFI increasing from 30.77% (April) to 44.12% (June). Nematodes were found only in *T. crocodilus* (30.77%, June). Developmental helminths were detected at low levels in *M. cephalus* (11.43%, May) and *R. kanagurta*.

Monthly trends: Parasitic infections generally increased from April to June. *T. jarbua* showed a consistent rise in prevalence of the Isopod (76.92% to 90.91%) parasites, while *R. kanagurta* peaked in May (69.23%) before a slight decline. *Dactylogyrus* sp. prevalence rose in both *Mugil cephalus* (24.62% to 36.76%) and *T. jarbua* (30.77% to 45.45%). *Caligus* spp. infections in *M. cephalus* also increased, suggesting a seasonal influence on parasite prevalence.

Histopathological Observations

Gill: Gill tissues infected with *Dactylogyrus* spp. (Fig. 14), *Caligus* spp. showed pronounced epithelial hyperplasia, lamellar fusion and curling. Inflammatory cell infiltration and mucus hypersecretion were evident. Similar pathological changes were also observed in Isopod-infected gills, along with tissue necrosis and mild oedema (Fig. 3-5).

Gut: Helminth developmental stages of parasites induced mucosal hyperplasia and thickening in the gut, accompanied by dense inflammatory infiltration and localized necrosis. Oedema disrupted the normal tissue architecture, suggesting impaired nutrient absorption and digestive function due to parasite-induced damage (Fig. 6 - 8).

Kidney: Infected fish kidney tissues exhibited hyperplasia of the renal tubules, inflammatory infiltration, oedema, and necrotic lesions. (Fig. 9-11).

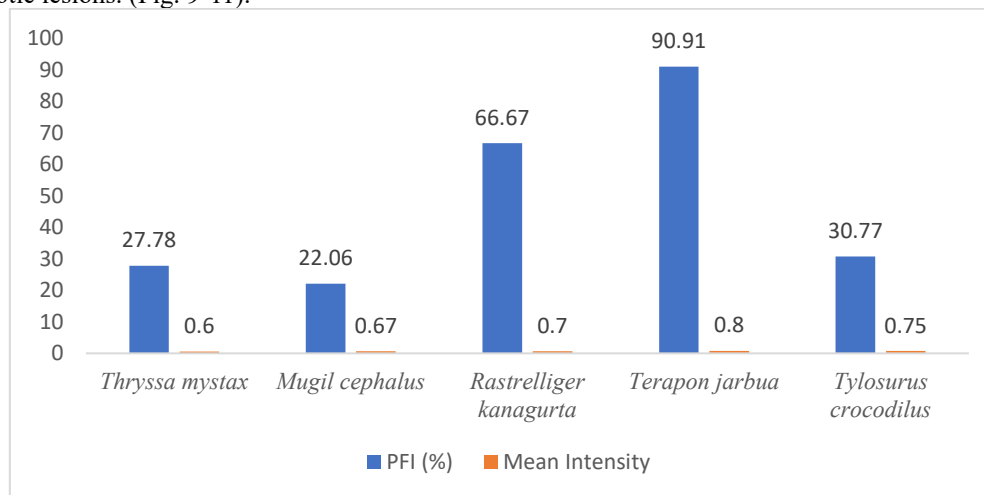


Fig. 1. PFI (%) and Mean Intensity of Isopod parasites among different fish species.

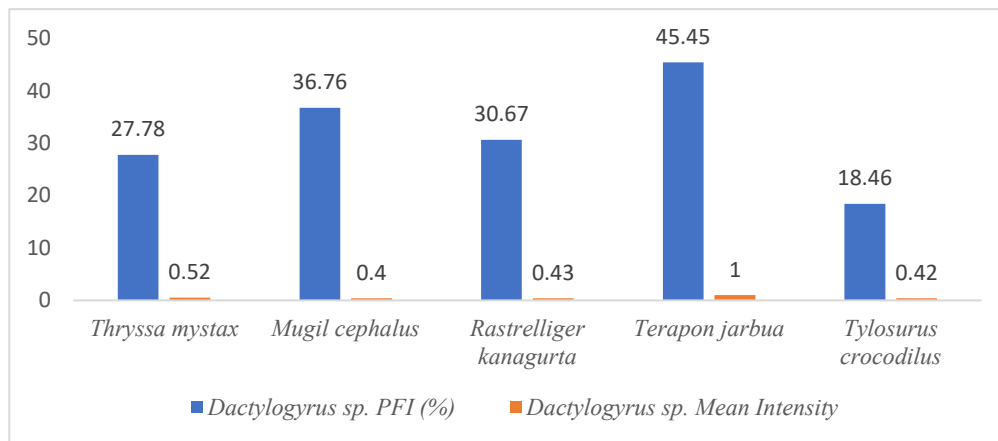


Fig. 2. PFI (%) and Mean Intensity of *Dactylogyrus* sp. parasites among different fish species.

Discussion

This study provides important insights into the dynamics of parasitic infections (Fig.12-14) in five marine food fish species such as *T.mystax*, *M. cephalus*, *R. kanagurta*, *T. jarbua*, and *T. Crocodiles* highlighting monthly and seasonal trends in parasite occurrence, as well as the prevalence and intensity of infections. Similar kind of seasonal parasitic study reported in the Indian mackerel associated with a secondary bacterial infection (Ramudu and Rathod 2024)

The highest isopod prevalence (90.91% in June) was recorded in *T. jarbua*, likely reflecting its habitat preference and feeding behavior. In *R. kanagurta*, highest prevalence noted in the month May, suggesting that environmental factors such as temperature and availability host in number may influence parasite transmission. These findings are corroborated with the previous studies (Ramudu and Rathod 2024). *M. cephalus* was observed infected with only *Caligus* spp., showed a clear seasonal increase, whereas *Dactylogyrus* spp. flukes were widely spread among the other hosts, with the highest PFI (%) observed in *T. jarbua*. Nematode parasites were limited to *T. crocodilus*, this indicating a high degree of host specificity. Similar kind of prevalence and intensity of the parasites reported in the Edible Fishes Landing at Karachi Fish Harbour (Shaheena and Zarrien 2012)

Mean intensity data revealed that *M. cephalus* carried high isopod loads despite moderate prevalence, while *T. crocodilus* had intense nematode infections in fewer individuals. These differences highlight varying host susceptibility and immune responses. Parasitic infestations/Infection rates were gradually increased from April to June in the present study. This may be coinciding with rising temperatures and pre-monsoon host aggregation factors that promote the parasite transmission. These observations are similar with Dey et al. (2022), who studied on *Channa punctatus* in low saline waters from the West Bengal.

Gill tissues infected with *Dactylogyrus* spp., *Caligus* spp. showed pronounced epithelial hyperplasia, lamellar fusion and curling. Inflammatory cell infiltration and mucus hypersecretion were evident. Similar gill pathological alterations have been widely reported in parasitized marine and freshwater fishes. Infection with *Dactylogyrus* spp. is known to induce severe epithelial hyperplasia, lamellar fusion, curling, excessive mucus secretion, and inflammatory cell infiltration, which impair respiratory efficiency (Buchmann & Bresciani 2006; Paperna 1996). Mulletts and perciform fishes infected with monogenean flukes showed similar histopathological lesions, including lamellar fusion and epithelial lifting (Roberts 2012). *Caligus* spp. parasites induced mucus hypersecretion, hyperplasia, epithelial erosion, haemorrhage in gill tissues, due to the parasite's attachment and feeding activities. These findings are similar with the previous studies in different fishes (Abdelsalam et al. 2024). Gill damage caused by isopod parasites has also been noted, with lesions characterized by epithelial disruption, necrosis, oedema, and localized Inflammatory responses at the attachment site (Rameshkumar & Ravichandran 2014; Ravichandran et al. 2010). These kinds of reactions of pathological changes affect the regular normal function of gill and induce host susceptibility to secondary bacterial, viral infections, ultimately affecting fish health/growth and survival.

Developmental stages of helminth parasites were found in the gastrointestinal tract of these marine food fishes. In the present study, helminth infections showed distinct mucosal hyperplasia and thickening of the intestinal wall, with dense inflammatory cell infiltration and necrosis. Similar intestinal lesions have been documented by the Paperna (1996) and Roberts (2012), where prolonged mechanical irritation and parasite attachment trigger host inflammatory responses due to the cestodes, nematodes, and acanthocephalans.

Chronic infection due to the helminth parasites with similar pathological lesions in *Mugil cephalus*, *Chanos chanos*, and *Rastrelliger* spp. were published in 2010 (Ravichandran et al. 2010). These kinds of alterations may affect the digestive performance and also weaken the host immunity and increase susceptibility to other bacterial infections. The present findings corroborate earlier observations (James 2022), in this highlights the pathological importance of helminth infections in fishes, advising the need for regular monitoring of parasites to ensure fish health as well as human health for the sustainability and seafood safety.

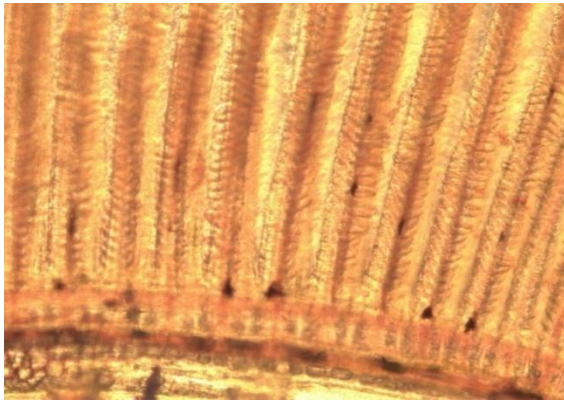


Fig.3 Wet mounts of normal gill structure (50x).

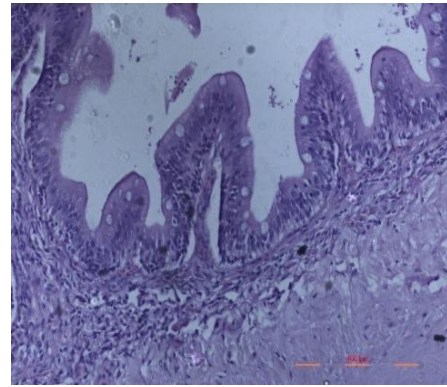
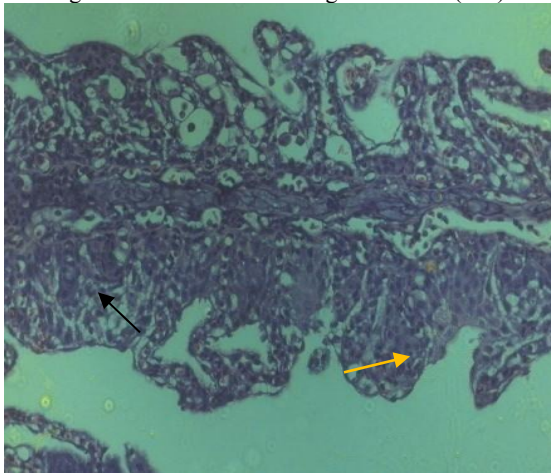
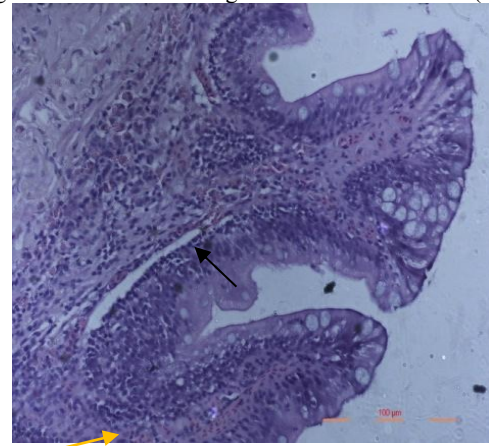
Fig 6 Normal structure of gut tissue of *T.crocodilus* (50x).Fig.4 Lamellar Fusion (Black arrow) and Inflammatory infiltration (Yellow arrow) in gill of *Mugil cephalus* (100x).

Fig. 7 Inflammatory infiltration (Black arrow) & dense cellular accumulations (Yellow arrow) apparently seen (50x).

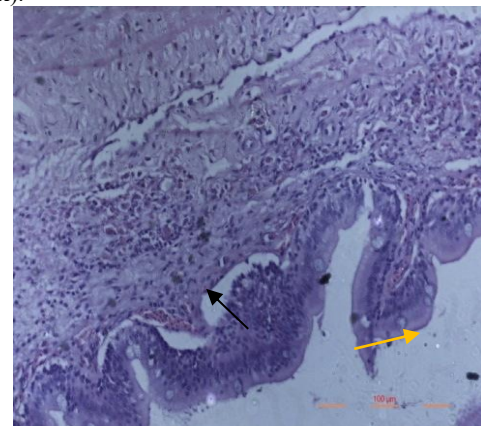
Fig. 5 *Datcylogyrous* spp. parasite (Black arrow) attached to the gill lamellae (50x).

Fig. 8 Mild oedema (Yellow arrow) & scattered necrotic zones seen (Black arrow) (50x).

In the current study, histopathological alterations kidney tissues including hyperplasia of renal tubules, inflammatory cell infiltration, oedema, and focal necrosis. Similar pathological changes reported in different fishes infected with helminths and other metazoan parasites (Ali et al. 2009; Paperna 1996; Roberts 2012). Similar renal pathological changes have been reported in freshwater food fishes due to exposed to the parasitic stress (Kaur et al. 2016).

Conclusion

Parasitic infestation was greatly prevalent in marine food fishes in this study (868 of 1,006 specimens infected), with predominant gill pathology, including epithelial hyperplasia, lamellar fusion, and necrosis, etc.; infestation dynamics were governed by ecological factors, host availability, and host susceptibility. Regular parasitological monitoring is recommended for management strategies and policy frameworks for sustainable fisheries and aquaculture.

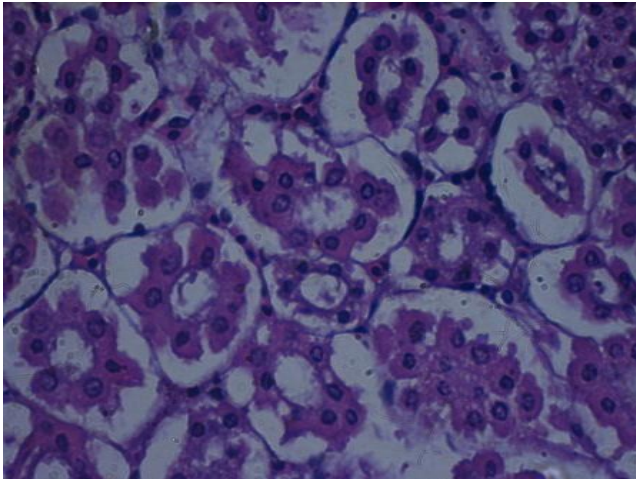


Fig.9 Normal Kidney structure of *Mugil cephalus* (100x).



Fig.12 Presence of isopod (*Nerocila* spp., Yellow arrow) in the abdomen of *Terapon jarbua*

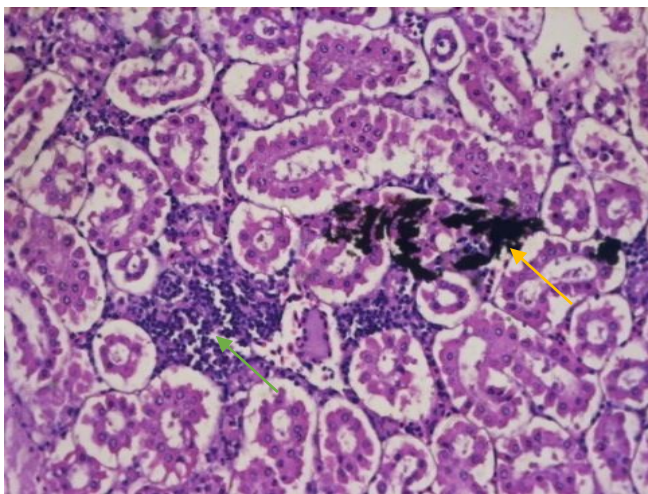


Fig.10 Necrosis (Yellow arrow) and hemocyte infiltration (green arrow) were seen in kidney tissues of *Mugil cephalus* (100x).

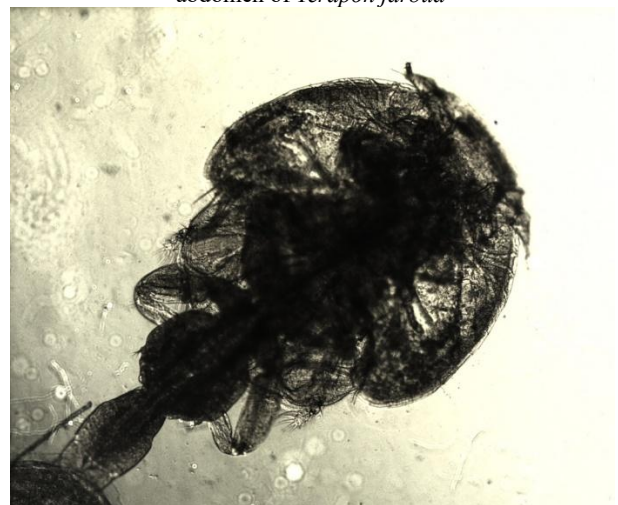


Fig.13 Isolated *Caligus* spp. parasite from the gill of the *Mugil cephalus*

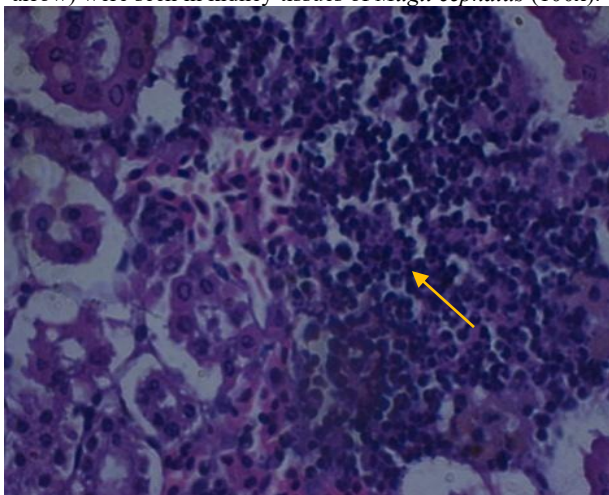


Fig. 11 Hyperplasia and Inflammatory infiltration of cells (Yellow arrow) seen in the kidney of *Mugil cephalus* (100x).

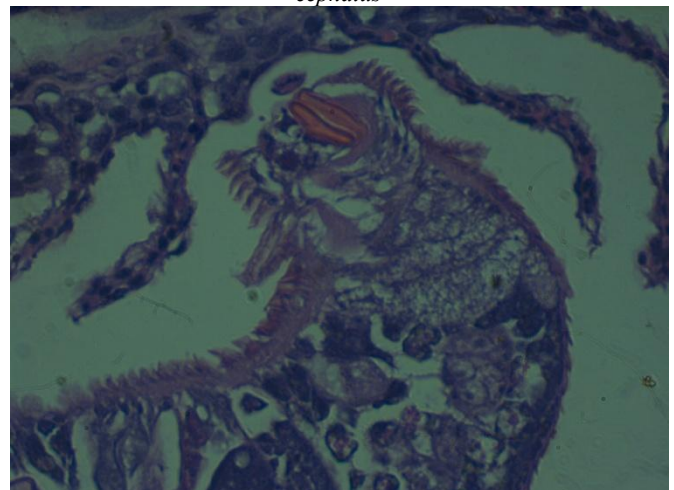


Fig.14. Higher magnification of gill with *Dactylogyrus* spp. (100x)

Author's contributions

Conceptualization: AT, KRR; Methodology: KRR, SBH; Data Collection: AT, KRR, LMJ; design, execution: AT, KRR, SBH, KC, LMJ; Writing Original Draft: KRR, SBH, S; Writing Review and Editing: KRR, AT, TH, S; Supervision: KC

Acknowledgments

The authors are thankful to the ICAR, DARE, Government of India, “Research was supported by the Indian Council of Agricultural Research, Department of Agricultural Research and Education, Government of India”. The Director, ICAR-CMFRI, Kochi; the Head, Marine Biotechnology, Fish Nutrition and Health Division, ICAR-CMFRI, Kochi; and the Scientist In-Charge, KRS, ICAR-CMFRI, Karwar, for the support and facilities provided which enabled the successful completion of this research work. The authors express their sincere gratitude to the Department of Studies in Marine Biology, Karnatak University, Dharwad (Karwar Campus), for their valuable guidance and encouragement throughout the work.

Conflict of interest

The authors declare no conflicts of interest.

Ethical statement

Ethical approval was not required for this study, as it did not involve procedures requiring such clearance, nor did it include research on protected fish species or work carried out in protected areas.

References

- 1) Abdelsalam M, Attia MM, Marzouk MS, Reda MS Korany, Mamdouh Y Elgendy, Asmaa W Soliman, Abdelbary Prince, Ahmed H Hamada (2024). Investigating dynamics, etiology, pathology, and therapeutic interventions of *Caligus clemensi* and *Vibrio alginolyticus* co-infection in farmed marine fish. *Sci Rep* 14, 20704 (2024). <https://doi.org/10.1038/s41598-024-70528-x>
- 2) Ali Abdel-Moneim, Metwally Mohamed, Hussein H, Elsheikha Hany (2009). Gross and microscopic pathological changes associated with parasitic infection in European eel (*Anguilla anguilla*, Linnaeus 1758). *Parasitology Research*. 106: 463-9. [10.1007/s00436-009-1688-2](https://doi.org/10.1007/s00436-009-1688-2).
- 3) Buchmann K (2012). Fish immune responses against endoparasitic nematodes - experimental models. *Journal of Fish Diseases*. 35(9): 623-35. <https://doi.org/10.1111/j.1365-2761.2012.01385.x>
- 4) Buchmann K, Bresciani J. (2006). Monogenea (phylum Platyhelminthes). In P. T. K. Woo (Ed.), *Fish diseases and disorders*, Vol. 1: Protozoan and metazoan infections (2nd ed. CABI Publishing 297–344.
- 5) Carlos AM, Lima dos Santos, Peter Howgate (2011). Fishborne Zoonotic Parasites and Aquaculture: A review, *Aquaculture*, 318(3–4): 253-261. <https://doi.org/10.1016/j.aquaculture.2011.05.046>.
- 6) Chai J Y, Murrell KD, Lymbery AJ (2005). Fish-borne parasitic zoonoses: Status and issues. *International Journal for Parasitology*, 35(11-12): 1233–1254. <https://doi.org/10.1016/j.ijpara.2005.07.013>
- 7) Dey A, Panda P, Dey C (2022). Seasonal variation in the prevalence, abundance, and mean intensity of acanthocephala infecting snake headed fish, *Channa punctatus* (bloch 1793) in hooghly district, west bengal, india. *Uttar Pradesh Journal of Zoology*. 622-631. doi :10.56557/upjoz/2022/v43i243375.
- 8) FAO (2022). The State of World Fisheries and Aquaculture. <https://doi.org/10.4060/cc0461en>
- 9) I. Muhammad, M.S. Sajid, S.O. Swar, M.K. Khan, M.A. Malik, A. Ahmad (2021). Parasitic Diseases of Fish, *Veterinary Pathobiology and Public Health*, 203-215. <https://doi.org/10.47278/book.vpph/2021.017>
- 10) J. Rooney, H M Northcote, Tim L Williams, Alba Cortés, Cinzia Cantacessi, Russell M Morphew (2022). Parasitic helminths and the host microbiome – a missing ‘extracellular vesicle-sized’ link?, *Trends in Parasitology*. 38(9): 737-747. <https://doi.org/10.1016/j.pt.2022.06.003>.
- 11) Kaur P, Shrivastav R, Qureshi TA (2016). Pathological effect on naturally infected kidneys of freshwater murels by *Euclinostomum heterostomum* metacercariae. *Journal of Parasitic Diseases*. 40(1):157-60. <https://doi.org/10.1007/s12639-014-0468-9>
- 12) Lightner DV (1993). Diseases of cultured penaeid shrimp. In: J.P. McVey (ed.), *Handbook of Mariculture. Crustacean Aquaculture*. Second Edition, CRC Press, Boca Raton, F.L., 1: 289-320.
- 13) Manoharan A, Srinivasan S (2017). Parasitic infections and their tissue response: a histopathological study. *International Journal of Research in Medical Sciences*, 4(6): 1938–1942. <https://doi.org/10.18203/2320-6012.ijrms20161737>
- 14) Martyniuk CJ, Li E, Rise ML (2025). Editorial: Environmental stressors and aquatic animal immune system function. *Front Immunol*. 1;16:1610969. <https://doi.org/10.3389/fimmu.2025.1610969>
- 15) Mustafa RA, Rather SA, Kousar R, Ashraf MV, Shah AA, Ahmad S, Khan MAH (2024). Comprehensive review on parasitic infections reported in the common fish found in UT of Jammu and Kashmir, India. *Journal of Parasitic Diseases*. 48(4):736-761. <https://doi.org/10.1007/s12639-024-01697-9>
- 16) Paperna I (1996). Parasites, infections and diseases of fishes in Africa. FAO/CIFA Technical Paper No. 31.
- 17) Rameshkumar G, Ravichandran S (2014). Problems caused by isopod parasites in commercial fishes. *Journal of Parasitic Diseases* 38: 138–141. <https://doi.org/10.1007/s12639-012-0210-4>
- 18) Ramudu KR, Dash G (2013). Prevalence of Monogenean Parasites on Indian Major Carps in Bheries of West Bengal, *Int Jour of Chemical and Biochemical Sciences*, 4:13-21. <https://www.iscientific.org/wp-content/uploads/2018/02/2-IJCBS-13-04-01.pdf>

- 19) Ramudu KR, Dash G (2016). Prevalence, morphology and scanning electron microscopy study of myxozoan parasites. *Journal of Parasitic Diseases*. 40: 339–347 (2016). <https://doi.org/10.1007/s12639-014-0505-8>
- 20) Ramudu KR, Rathod JL (2024). Seasonal parasitic study on Indian mackerel, *Rastrelliger kanagurta* (Cuvier, 1817) associated with a secondary bacterial infection in Karwar, Uttara Kannada, Karnataka. *Journal of Experimental Zoology India* 27, 667- 672. <https://doi.org/10.51470/jez.2024.27.1.667>
- 21) Ramudu KR, Rehman S, Raj PP, Lincy MJ, Gora AH, Sharma KSR, Hussain T, Kalidas C (2026). Molecular and histopathological insights of *Amyloodinium ocellatum* infection in Maroon Clownfish. *Journal of Livestock Science* 17: 515-523 doi. 10.33259/JLivestSci.2026.515-523
- 22) Ravichandran S, Rameshkumar G, Balasubramanian T (2010). Infestation of isopod parasites in commercial marine fishes. *Journal of Parasitic Diseases*. 34(2):97-8. <https://doi.org/10.1007/s12639-010-0014-3>
- 23) Rifat MA, Md. Abdul Wahab, Muhammad Arifur Rahman, Md. Nahiduzzaman, Abdullah-Al Mamun (2023). Nutritional value of the marine fish in Bangladesh and their potential to address malnutrition: A review, *Heliyon*, (9):2,e13385, <https://doi.org/10.1016/j.heliyon.2023.e13385>.
- 24) Roberts RJ (2012). *Fish pathology* (4th ed.). Wiley-Blackwell. <https://doi.org/10.1002/9781118222942>
- 25) Shaheena Qasim, Zarrien Ayub (2012). Prevalence and Intensity of Parasites in Edible Fishes Landing at Karachi Fish Harbour, *Pakistan Journal of Zoology*, vol. 44(6): 1467-1471.
- 26) Woo PTK (Ed.) (2006). *Fish diseases and disorders*. 1: Protozoan and metazoan infections (2nd ed.). CABI Publishing.