COMPARATIVE ANALYSIS OF INFESTATION INDEX VALUES OF HELMINTH PARASITES IN FRESHWATER BODIES OF THE WASHIM REGION

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Abstract
Fish are an excellent source of high-quality protein, containing all nine essential amino acids, making them a complete protein essential for muscle repair, growth, and overall health. However, fish are susceptible to both ectoparasites and endoparasites. Ectoparasites target the external surfaces of fish, such as the skin, gills, and fins. The Infestation Index (or Infection Index) of helminth parasites in fish is a metric used to assess the extent of parasitic infestation, helping to determine the prevalence, intensity, and distribution of infections. A study conducted on the freshwater bodies of the Washim region aimed to evaluate the current and comparative status of fish species. The findings indicated that the infestation index of helminth parasites in Channa striata and Ompok bimaculatus was lower than that in Mastacembelus armatus. The highest rates of parasitic infestations were recorded during the summer months in freshwater fish. The study also emphasized the detrimental impact of anthropogenic activities since 2021, which have led to a decline in fish species due to habitat destruction and pollution caused by illegal constructions and human activities. The analysis showed that the occurrence of helminth parasites varies depending on factors such as season, host species, host size, feeding habitats, and localities. The highest parasite infections were observed in summer, followed by winter, while the rainy season showed the lowest levels. Nematode parasites were particularly prevalent in the stomach and digestive systems of Mastacembelus armatus. These parasites disrupt the physiological functions of the affected fish, potentially causing epidemics, mortality, and significant economic losses. Furthermore, there is a risk of human transmission through the consumption of raw or undercooked infected fish. Post-pandemic studies revealed a noticeable decline in the availability of fish species in the area.
Keywords: *Helminth parasites, Ompok bimaculatus, Channa striata, Mastacembelus armatus.*

Introduction

Fish are of significant importance to humans as they provide a rich source of high-quality protein, essential amino acids, and omega-3 fatty acids, contributing to muscle repair, growth, and overall health **[1,2,3]**. They are a major part of global diets and also support vast commercial and recreational fishing industries. Fish species can also be kept in aquariums for ornamental purposes, or cultivated in fish farms for commercial aquaculture. Fish parasites are organisms that live in or on fish, often at the expense of their host. These parasites can significantly affect the health and well-being of fish, leading to diseases, growth reduction, and even death. Fish parasites can be broadly classified into two categories: ectoparasites (external parasites) and endoparasites (internal parasites). Fish can be infested by helminth parasites, which are parasitic worms that infect the internal or external organs of fish. These parasites can significantly impact the health of fish, affecting their growth, reproductive capacity, and overall survival. Helminth parasites in fish belong to three main classes: nematodes (roundworms), cestodes (tapeworms), and trematodes (flukes).

Objectives:

1. To conduct a study of selected freshwater bodies and collect an adequate number of specimens for the designated research.
2. To identify endoparasites from the stomach and intestines of the selected freshwater fish species using appropriate identification keys.
3. To determine the prevalence and comparative status of parasites observed in the selected fish species from two different localities and present the data using proper bio-statistical methods.
4. To assess the host-parasite relationship in the selected fish species.
5. To document the parasites collected from fish specimens through digital photography, whenever possible.

Materials And Methods:

A. Study Area

The study area of Washim is located in the state of Maharashtra, India. Washim is a district in the Vidarbha region, known for its agricultural activities, including crop cultivation and fish farming. It is characterized by several freshwater bodies, including rivers, lakes, and ponds, which are essential habitats for a variety of fish species. In the context of parasitological studies on fish, Washim's freshwater bodies provide a suitable

environment for studying various fish species and the parasites that inhabit them. These water bodies can host both ectoparasites and endoparasites, which can significantly affect fish health and the surrounding ecosystem. The district's biodiversity, combined with environmental factors such as seasonal changes and anthropogenic activities, makes it an ideal location for investigating the prevalence and intensity of parasitic infestations in freshwater fish populations.

B. Methodology

- **Time of Collection:** Fish specimens should be collected at regular intervals throughout the year, considering seasonal variations (summer, winter, and rainy seasons) to study the impact of seasonality on parasite prevalence.
- **Methods of Capture:** Use appropriate fishing methods such as nets, traps, or hook-and-line fishing to collect the target fish species. Standardized techniques should be employed to ensure a representative sample size.
- **Target Fish Species:** Select a range of common freshwater fish species found in the study area, such as *Channa striata*, *Ompok bimaculatus*, *Mastacembelus armatus*, and other locally abundant species. The species should be chosen based on their ecological significance, abundance, and potential exposure to parasites.
- **Handling and Transportation:**After collection, fish specimens should be handled with care to minimize stress and prevent injury or contamination.Fish should be transported to the laboratory in suitable containers with adequate water, ensuring proper aeration and temperature control to maintain fish health.
- **Identification and Measurement of Host Fish:** Upon reaching the laboratory, each fish should be identified to the species level using taxonomic keys. Record essential data such as fish species, size (length and weight), sex (if identifiable), and health status (presence of any visible abnormalities). Measure the standard length and weight of the fish to assess the size-related distribution of parasites.
- **Preparation for Dissection:** Prepare the fish specimens for dissection by euthanizing them using approved humane methods, ensuring that they are not subjected to prolonged stress.Dissect the fish to access internal organs (stomach, intestines, liver, gills) where parasites are likely to be found.
- **Preservation of Samples:**Parasites collected from the fish should be carefully preserved in appropriate fixatives (e.g., formalin or alcohol) for further study. Samples should be labeled clearly, including fish species, collection date, and study site for accurate tracking.

Ecological Analysis of Fish Parasites: Ecological terms are studied as per the formula given by Margolis.

Prevalence Calculation: The prevalence of each parasite species is calculated as the percentage of infected fish in the sample. This is a measure of how widespread the parasite is within the fish population.

$$\textbf{Prevalence} = \frac{\text{Total No. of hosts infected}}{\text{Total No. of hosts examined}} x100$$

Intensity of Infestation: The intensity of infection refers to the number of parasites per infected fish, providing an idea of the parasite load. It can be calculated as the average number of parasites found per infected fish.

$$\textbf{Mean Intensity} = \frac{\text{Total No. of parasites collected}}{\text{Total No. of Infected Hosts}}$$

$$\textbf{Abundance} = \frac{\text{Total No.of parasites collected in a sample}}{\text{Total No.of Hosts Examined}}$$

$$\textbf{Index of Infection} = \frac{\text{No. of host infected x No. of parasite collected}}{\text{Total No. of Hosts examined}}$$

Results and Observations:

The study aims to assess and predict the current and comparative status of freshwater bodies in the Washim region. infestation index of helminth parasites in *Channa striata* and *Ompok bimaculatus* is less as compare to *Mastacembelus armatus.* The **infestation of parasites** in fish can vary significantly with **seasonal changes**, influencing factors like water temperature, fish behavior, availability of hosts for parasites, and environmental conditions. Seasonal variations often affect the prevalence, intensity, and distribution of parasites in aquatic ecosystems. Warmer water temperatures in the summer can accelerate the life cycle of parasites, leading to higher rates of parasitic reproduction and growth. Many parasites,

especially helminths (like nematodes), thrive in warmer conditions. The higher temperatures encourage more active feeding and growth in both fish and parasites. This results in an increased number of parasites infecting fish, particularly those living in shallow or warm water areas. During colder months, many parasites exhibit a slower life cycle due to the reduced metabolic rates in the aquatic environment. This leads to a reduction in the reproduction and activity levels of many parasites, especially those sensitive to temperature changes. The rainy season can lead to changes in the water environment, such as increased water levels and runoff, which may introduce new hosts or increase parasite populations in certain areas. Rain can also wash in new parasite eggs and larvae from surrounding areas, leading to higher parasite exposure for fish.

Prevalence, Mean Intensity, Abundance rate and Index of infection:

Out of the 135 fish specimens examined in the Washim region, 42 were found to be infected with endoparasites, which were identified as nematodes. The fish species examined included *Ompok bimaculatus* (40 specimens), *Channa striata* (52 specimens), and *Mastacembelus armatus* (43 specimens). The study revealed that the prevalence of infection was highest during the summer season, followed by winter and rainy seasons. The maximum prevalence (72.72%) was observed in *Mastacembelus armatus* during summer, while the minimum prevalence (6.66%) occurred in *Ompok bimaculatus* during winter. The highest mean intensity (6.3%) was recorded in *Channa striata* in winter, while the lowest intensity (1.3%) was seen in *Mastacembelus armatus*. The abundance rate was highest in *Mastacembelus armatus* during summer (1.45%), whereas it was lowest in *Channa striata* during the rainy season (0.16%). The infestation index was also highest in *Mastacembelus armatus* during summer (11.63%) and lowest in *Ompok bimaculatus* during winter (0.20%) (Table).

Host-Parasite Relationship:

Host Species and Susceptibility: Analyze the relationship between host species and parasite infestation. Some fish species may be more susceptible to certain parasites due to their physiology, habitat preferences, or feeding behavior.

Fish Size and Parasite Load: Examine whether fish size (length/weight) correlates with parasite load. Larger fish may harbor more parasites, or younger, smaller fish might be more susceptible to infections.

Age and Immunity: Older fish may develop acquired immunity against certain parasites, reducing the parasite load. Compare parasite prevalence in different age groups within the fish population.

Discussions

Food Safety Regulations and Public Health

The presence of parasites in fish has prompted the establishment of food safety regulations aimed at protecting consumers. These regulations typically include guidelines on proper freezing or cooking techniques to eliminate parasites before consumption. The World Health Organization (WHO) and local health authorities often monitor fish markets and aquaculture facilities to ensure that fish intended for human consumption are free from parasites. In regions where parasitic infections are common, educating the public on safe fish consumption practices, such as cooking fish to the recommended temperature or freezing it before eating, is crucial. If not addressed, the widespread prevalence of parasitic infestations could lead to an increase in foodborne diseases, potentially resulting in a public health crisis.

Fish diseases and parasite:

Fish, whether in the wild or in aquaculture, are susceptible to various diseases caused by parasites, bacteria, viruses, and fungi. Parasites, living on or inside the fish, often cause harm to their host. These infections can lead to numerous health issues for the fish and have significant economic and ecological consequences. Parasitic worms can infect internal organs such as the digestive system, liver, and others. While these parasites are commonly found in wild fish, they can also affect farmed fish. For example, tapeworms can infect the digestive tract, and some species are zoonotic, meaning they can be transmitted to humans. Trematodes, another type of parasitic flatworm, can infect various organs, including the liver, lungs, and intestines, and may cause diseases like liver fluke infections in humans. Parasites can damage organs, weaken the immune system, and increase fish vulnerability to other infections, often resulting in higher mortality rates. The physiological effects of parasitism, such as reduced nutrient absorption and organ damage, can impair growth and reproduction in affected fish. In aquaculture, parasitic infections can lead to significant economic losses due to the need for costly treatments, poor growth, or fish mortality. Infected fish may also become unfit for sale, causing financial losses for fish farmers and fishers.

Conclusion

This study highlights the complex relationship between fish size, seasonal variations, and parasitic infestations. Larger fish typically host more parasites due to their increased surface area and internal organ space. Seasonal factors, such as temperature and rainfall, play a significant role in influencing the prevalence and intensity of parasitic infections, with warmer months often showing higher parasite loads. Human-induced pressures on the aquatic environment further exacerbate these issues by weakening fish populations and impairing their immune responses. Additionally, the risk of human transmission of parasitic diseases from infected fish emphasizes the need for ongoing monitoring and management of aquatic health, especially in regions impacted by environmental degradation and pollution. Parasitic infections in fish pose a significant threat to both aquaculture and wild fisheries, affecting fish health, the economic stability of the fishing industry, and public health. Early detection, effective fish management, and preventive measures, including safe cooking practices, are essential in mitigating the impact of fish parasites. Ongoing research into better treatment options and parasite control strategies will be key to reducing these infections and ensuring the sustainability of fish populations and the safety of fish consumption.

Recommendations:

- Increase awareness among fish farmers, fishers, and the general public regarding the significance of fish health and parasite management practices.
- Conduct regular health checks on both wild and farmed fish populations to detect the presence of parasites early. This includes microscopic examination of fish skin, gills, and internal organs.
- Focus on developing non-chemical treatments such as biological controls or vaccines that could provide more sustainable methods for controlling fish parasite infections.
- Educate the public about the risks of consuming raw or undercooked fish. Encourage proper cooking practices to kill any potential parasites.
- Educate fish farmers and fishery workers on the importance of maintaining high biosecurity standards to reduce the spread of parasites.
- Isolate new fish before introducing them into existing populations in aquaculture facilities to prevent the spread of parasites from infected fish.

Observation Tables and Figures:

Table: Infestation index of Helminth parasites in selected freshwater species at study area with respect to seasonal variations:

Fish Species	Seasons	Prevalence rate	Mean intensity	Abundance rate	Infestation index
Channa striata	Summer 2023	**60%**	**1.6**	**0.40**	**3.6**
	Rainy 2023	**27.77%**	**3.6**	**0.16**	**0.83**
	Winter 2023	**15.78%**	**6.3**	**0.21**	**0.63**
Ompok bimaculatus	Summer 2023	**28.57%**	**3.5**	**0.28**	**1.14**
	Rainy 2023	**18.18%**	**5.5**	**0.18**	**0.36**
	Winter 2023	**6.66%**	**15**	**0.20**	**0.20**
Mastacembelus armatus	Summer 2023	**72.72%**	**1.3**	**1.45**	**11.63**
	Rainy 2023	**40%**	**2.5**	**0.60**	**3.6**
	Winter 2023	**23.52%**	**4.25**	**0.29**	**1.17**

Figure 1

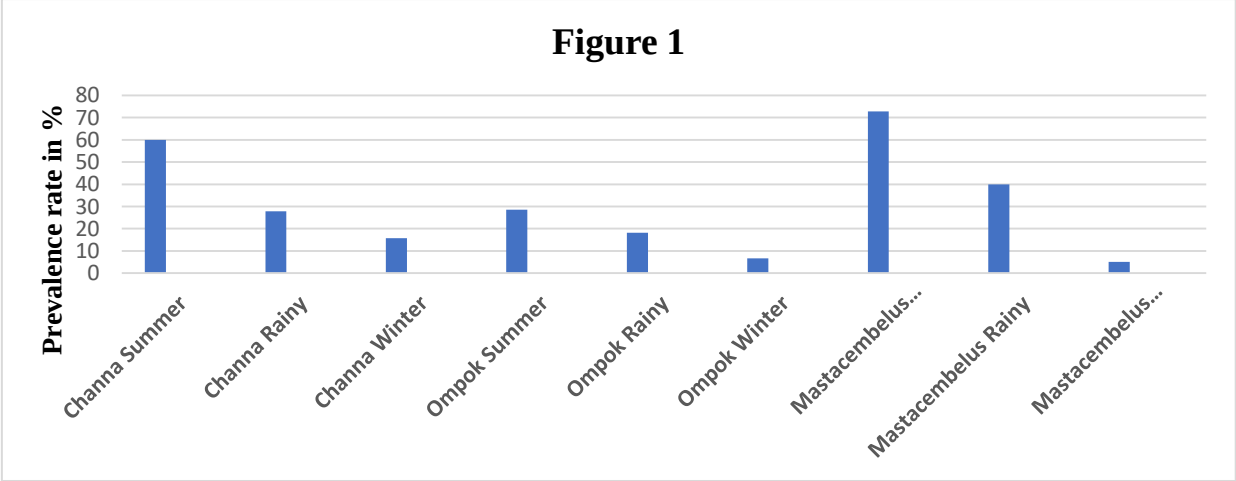


Figure 2

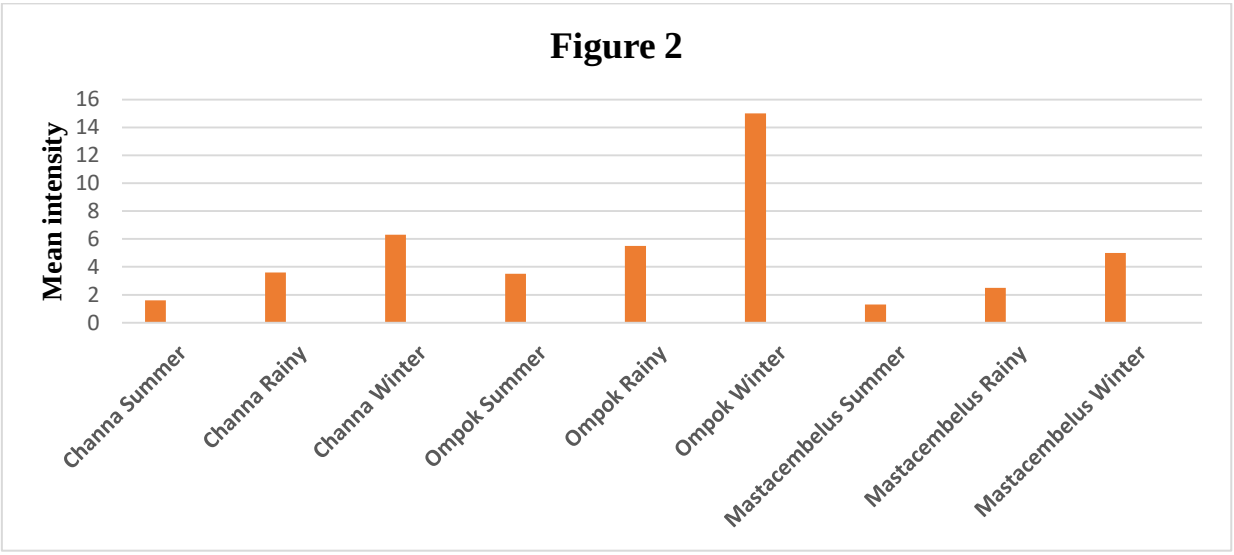


Figure 3

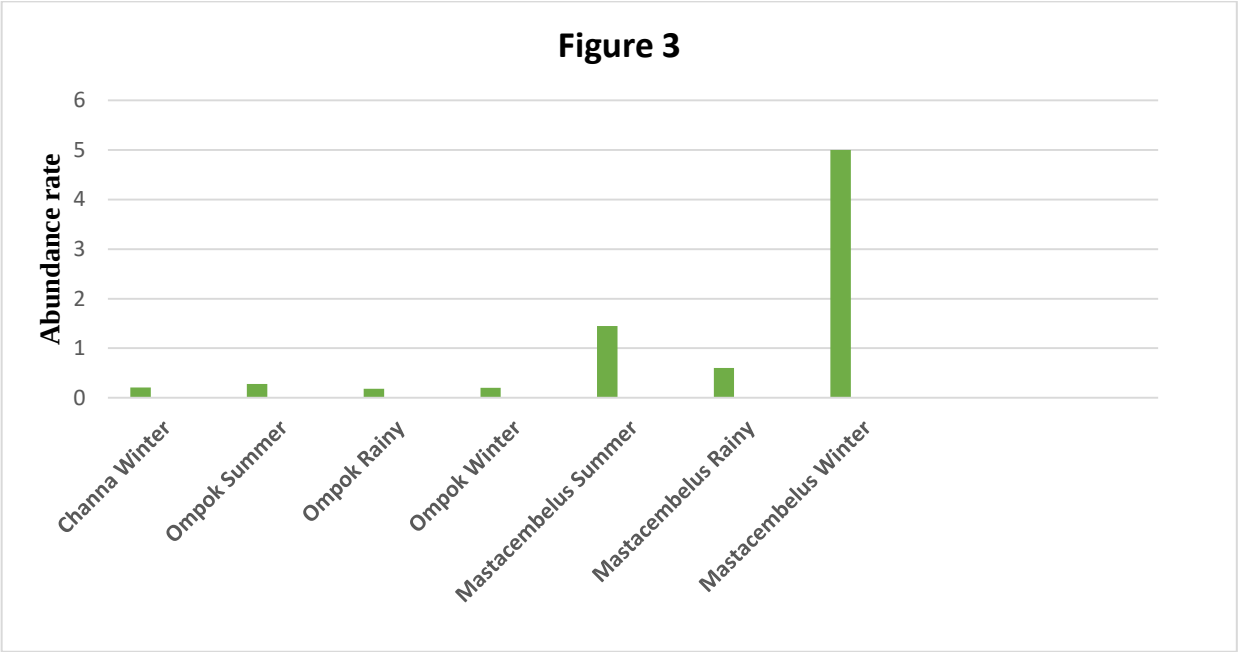
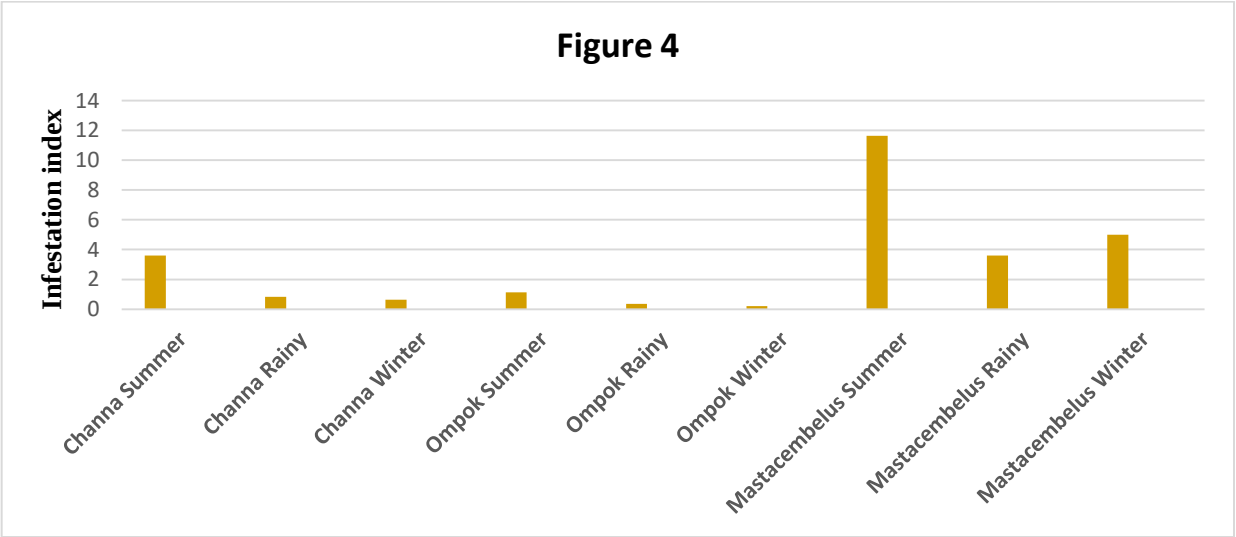


Figure 4



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