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Impact of Various Environmental Factors on the Growth of Fresh Water Fish *Cyprinus carpio*

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Abstract: Increases in aquaculture production are contributing to the current 160 million-ton worldwide fisheries production. The temperature of the water and the availability of food are two examples of environmental elements that clearly and significantly affect growth rate and food conversion efficiency. Therefore, present study focuses on the correlation between the seasonal variations in environmental factors like temperature, pH, dissolved oxygen levels and nutrient levels of fresh water fish in a selected site of Tamil Nadu, India. The study revealed that, growth of the fish *Cyprinus carpio* was highly influenced by various environmental factors. It was revealed that, one of the most significant ecological variables that affect aquatic creatures' behaviour and physiological functions is the temperature of their surroundings.

Keywords: Fish production, *Cyprinus carpio*, Productivity, Aquaculture, Physical Parameters

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Introduction

In underdeveloped nations, fish has been crucial to meeting people's nutritional needs and securing their livelihoods. With its rich aquatic wildlife and flora, Tamil Nadu is a leading state with marine, inland, and coastal waters. Inland fish in Tamil Nadu was 2.47 lakh MT in 2023–2024. With 43.11% of India's endemic freshwater fishes and 40.09% of the Western Ghats' endemic fish diversity, the state also boasts a wide diversity of endemic freshwater fish species. (Fish Production, 2003).

Growth is a measurement of the change in size of the entire body or of a specific body part; growth rate is a measurement of the change in size over time; and development reflects the order of life-history stages. The amount and quality of food consumed determines growth, and poor nutrition can impede growth and postpone developmental phases like the beginning of sexual maturation. The global ecosystem, biodiversity, and sustainable human development are all under increasing and serious threat from climate change,

mostly due to changes in the water cycle, global heat regimes, and acidification (Wenger *et al*., 2011; Kroeker *et al.*, 2013).

It is recognized that freshwater and marine aquatic habitats, as well as the creatures that inhabit them, are even more susceptible to climate change than their terrestrial counterparts. (Williamson *et al.*, 2008). Both the diversity of wild fish and global fisheries face an uncertain future due to their great susceptibility to environmental changes brought on by climate change (Xenopoulos *et al.*, 2005)

Fundamentally, fish growth is the result of the synergistic interactions between environmental factors and gene-determined growth potential (Wenger *et al*., 2011). Therefore, one of the most important and effective ways to forecast how climate change will affect populations, communities, and even ecosystems is to understand how fish growth responds to changing circumstances (Ding *et al*., 2020). Many major stresses, including fisheries exploitation, impact many fish populations. Population complexity can be steadily decreased through selective harvesting (Kroeker *et al.*, 2013), causing modifications to life history (Wenger *et al*., 2011) and demography (Xenopoulos *et al.,* 2005).

The present study focuses on the correlation between the seasonal variations in environmental factors like temperature, pH, dissolved oxygen levels and nutrient levels of fresh water fish in a selected site of Tamil Nadu, India.

Materials and Methods

Study Site

For the study, Avathanapatti Lake, a water body near Krishnagiri, India was chosen. Seasonal rainfall and water from the Krishnagiri dam provide the lake with a steady supply of water all year long.

Sample Collection

For 12 months, from July to June, fish samples (*Cyprinus carpio*; Common carp) and water from the pond were taken every month, and physiochemical data were recorded. During this time, fish samples were collected with the objective to measure the monthly growth rate and determine how environmental conditions influence fish growth.

Measurement of the temperature and pH

A Mercury thermometer was used directly to measure the water sample's temperature and a portable digital pH meter was used to measure the water sample's pH directly.

Dissolved oxygen level

Water samples were collected in BOD bottles and brought to the lab to determine the dissolved oxygen levels. The Winkler method was used in order to calculate DO values.

Water transparency

The Secchi disc method was used to measure the clarity of the water.

Measurement of Fish growth

Growth of fish was calculated as follow:

$$\text{Growth} = ((W2 - W1) / (t \times W1)) \times 100$$

Where, W2 is the average fish weight (in g) in the given time period, W1 is average fish weight (in g) in the previous time period, and t is the time period (in days) between the two measurements.

Results

Fish growth

The annual variation in growth of fish i depicted in Figure 1., during the time period from October to September. It is evident that the growth rate is increasing steadily, with September recording the highest rise.

Variation of Monthly Temperature

By averaging the pond's monthly surface and bottom temperatures, the water temperature was estimated. In December, temperature of the water was 20°C, and in May, it was 33°C (Fig. 2).

Variation of Water pH

The pH of the water was determined by averaging

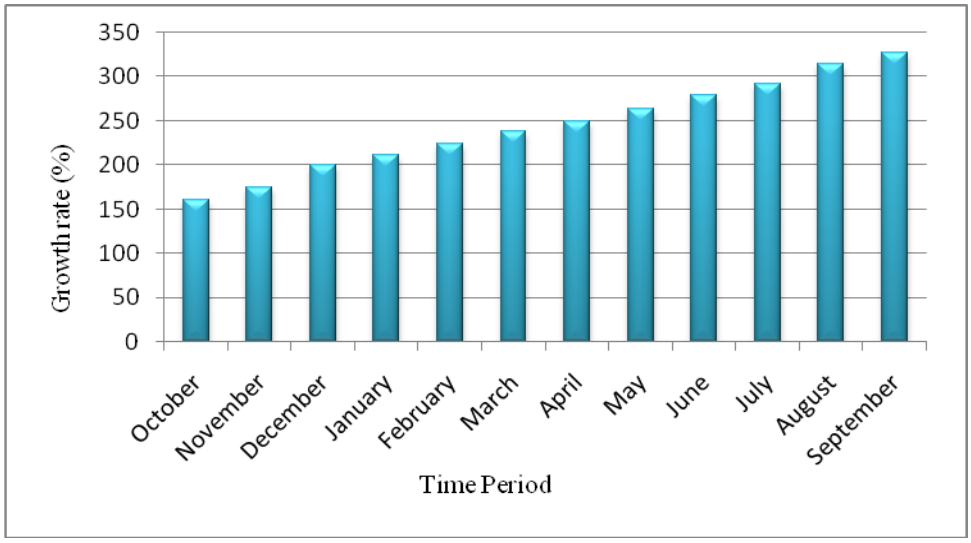

Fig. 1: Average Fish growth rate during the month from October to September.

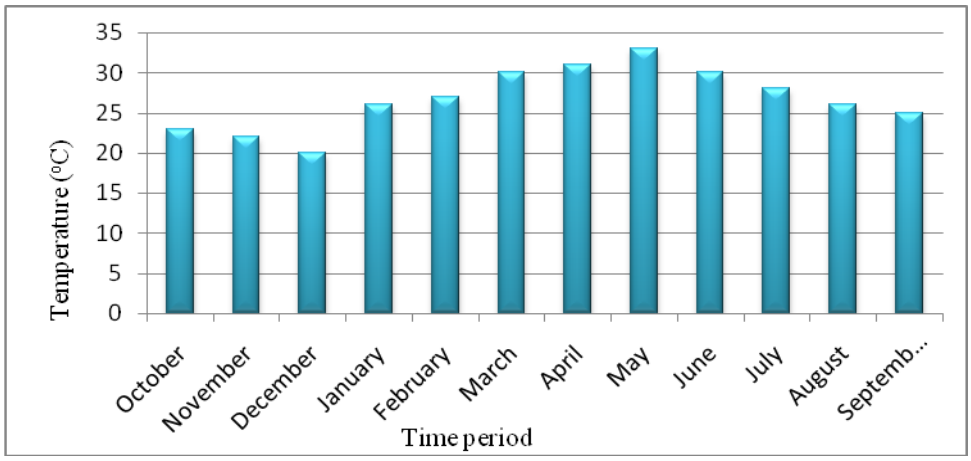

Fig. 2: Average monthly Temperature during the month from October to September.

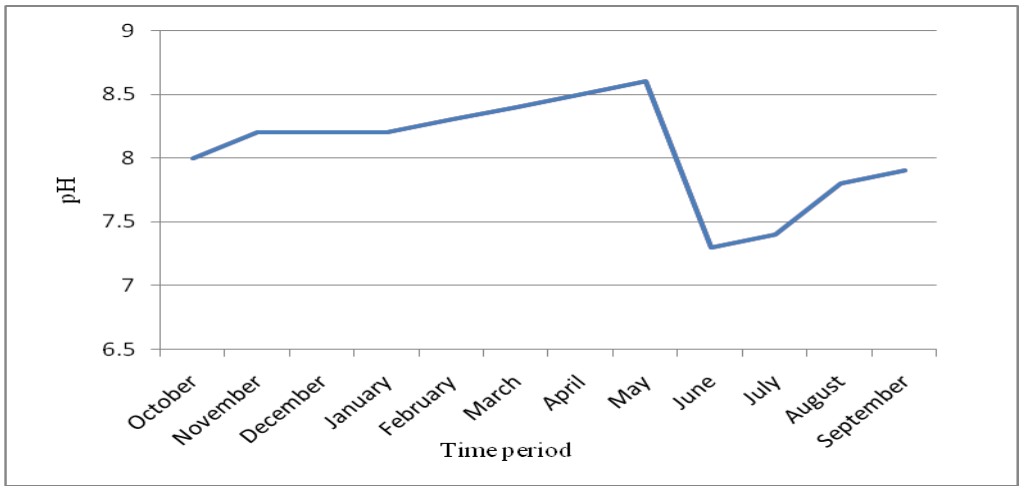

Fig. 3: Average monthly pH during the month from October to September.

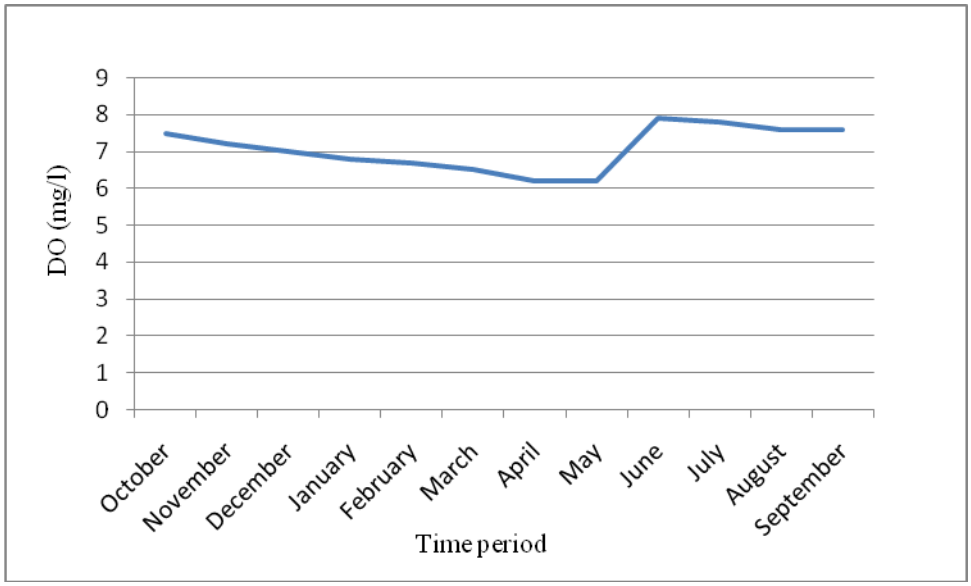

Fig. 4: Average monthly DO during the month from October to September.

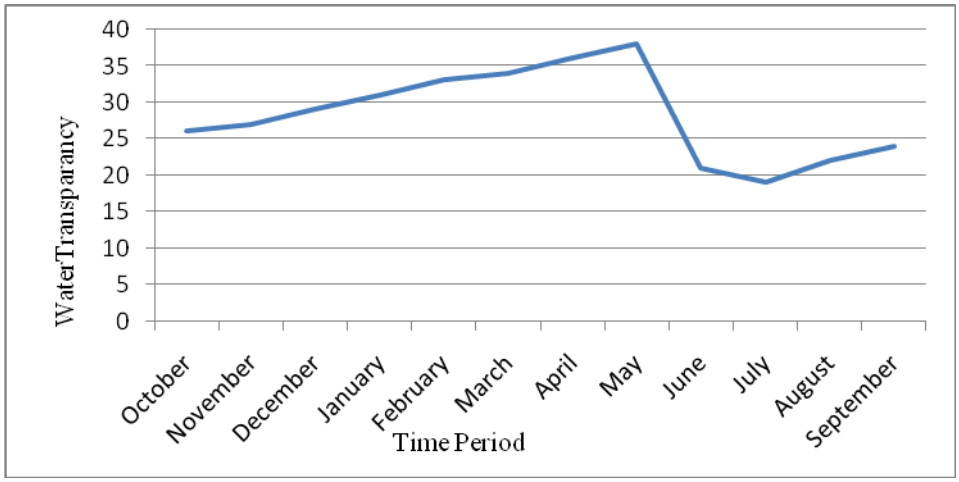

Fig. 5: Average monthly water transparency during the month from October to September.

the surface and bottom pH values. The maximum pH was obtained in the month of May and minimum was obtained during June. The pH of the water was found to be in the alkaline range (Fig. 3).

Dissolved Oxygen concentration

Seasonal fluctuations were seen in the dissolved oxygen (DO) levels, with the highest levels recorded in June and the lowest in April and May (Fig. 4).

Water Transparency

The "water transparency" describes how light can flow through water, which basically determines how clear or muddy the water appears. May was the month with the highest water transparency in the current study, while July had the lowest (Fig. 5).

Discussion

Monthly average growth rate of *Cyprinus carpio* were estimated along with various physical and chemical conditions like water temperature, pH, dissolved oxygen and transparency of water. In

the present study, during the time period from October to September, growth rate is increasing steadily, with September recording the highest rise. Body size will decrease in any case of global warming, according to Lorenzen (2016). Reduced body size may have significant negative impacts on ecosystems, economic losses, and the energy and nutrient web in addition to decreasing animal fitness. Additionally, the southwest monsoon season promotes natural fish spawning, especially for species like common carp, which makes it a good time of year for fish farming.

Likewise, the temperature of the water was obtained minimum in December (20°C), and maximum in May (33°C). According to Boltana *et al.* (2017), one of the primary abiotic factors influencing fish body size is temperature. In the same way, Oke *et al.* (2020) noted that ectotherm organisms, such as fish, have been shown to experience a decrease in body size when temperatures rise. A pH of 6.5 to 7.00 is optimum for aquaculture in fresh water, according to numerous findings (Brine and Austin, 1981). Likewise, Bryan and Swanson (2011) found that a pH below 6.0 results in stunted development and decreased production. Lorenzen's (2016) suggested that fish development and the general health of ponds are greatly impacted by water transparency, or the absence of turbidity.

The highest level of DO recorded in June and the lowest was estimated in April and May month. Mallya (2007) noted that as oxygen is necessary for respiration and metabolism, fish performance will be impacted by the amount of dissolved oxygen (DO) in the water. The amount of DO in the water column would depend on environmental factors such as oxygen, partial pressure, water temperature, and salinity as well as aquatic species' oxygen consumption (biological oxygen requirement).

Conclusion

With implications for ecology, evolution, and conservation, fish development rate is a crucial characteristic. One major abiotic factor influencing fish body size is temperature. In addition to lowering species fitness, reducing body size may also disrupt the energy and nutrient web, disrupt the environment, and result in financial losses. Thus, the present research contributes to the comprehension of how physico-chemical parameters impact aquatic organisms like fish.

Ethical Statement

The authors confirm that all ethical issues have been dealt with the research ethics guidelines provided by the .G and Research Department of Zoology, N.S.S College, Pandalam, Pathanamthitta 689501, Kerala, India.

Author Contributions

Each author has contributed equally to the study's planning, analysis, writing, and editing.All authors have read and agreed to the published version of the manuscript.

Conflict of Interest

The authors declare no conflicts of interest.

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