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Commentary

Understanding Temperature-Induced Changes in Rohu Carp Habitats

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DESCRIPTION

The major carp species, Rohu (*Labeo rohita*), holds significant economic and cultural importance in aquaculture and fisheries across Asia. As ectothermic organisms, fish are highly sensitive to environmental factors, particularly temperature fluctuations. Understanding the physiological responses of Rohu to temperature variations is significant for optimizing aquaculture practices, ensuring sustainable production, and mitigating the impacts of climate change. This article explores the intricate relationship between temperature and biological alterations in Rohu, focusing on the physiological mechanisms and implications for aquaculture management.

Rohu exhibits a narrow range of thermal tolerance, with optimal growth and metabolic rates occurring within specific temperature thresholds. Extremes in temperature, either too high or too low, can disrupt physiological processes and induce stress responses in Rohu. At lower temperatures, metabolic rates decrease, leading to reduced feed intake, growth retardation, and delayed maturation in Rohu. Cold stress also compromises immune function, making fish more susceptible to diseases and infections. Conversely, exposure to high temperatures can accelerate metabolic rates, deplete oxygen levels, and increase oxidative stress, negatively impacting growth performance and survival rates.

Temperature-induced biological alterations in Rohu manifest at various levels, from cellular responses to whole-organism adaptations. Understanding these physiological responses provides insights into the mechanisms underlying temperature tolerance and acclimation in this species. Temperature fluctuations affect the fluidity and permeability of cell membranes in Rohu. Cold temperatures decrease membrane fluidity, impairing nutrient uptake and cellular communication. Conversely, heat stress destabilizes membranes, leading to leakage of ions and metabolites. Extreme temperatures can denature proteins, disrupting their structure and function. Heat Shock Proteins (HSPs) play a vital role in protecting cellular proteins from thermal damage by facilitating refolding and repair processes.

Rohu adjusts its metabolic rates in response to temperature changes to maintain energy homeostasis. Cold temperatures reduce metabolic activity, conserving energy for essential functions such as survival and maintenance. In contrast, warm temperatures increase metabolic demands, requiring higher energy expenditure for growth and reproduction. Temperature influences oxygen consumption rates in Rohu, with higher temperatures leading to increased oxygen demand due to elevated metabolic rates. Adequate oxygen availability is essential to prevent hypoxia and ensure aerobic respiration in fish exposed to warm temperatures.

Temperature stress disrupts the endocrine system of Rohu, altering the secretion and activity of hormones involved in growth, reproduction, and stress responses. Cortisol, the primary stress hormone, is elevated under thermal stress conditions, triggering physiological adaptations to cope with environmental challenges. Temperature fluctuations influence the reproductive physiology of Rohu, affecting gonadal development, spawning behavior, and fertility. Warm temperatures accelerate gonadal maturation and spawning activity, while cold temperatures delay or inhibit reproductive processes.

In aquaculture settings, maintaining optimal water temperatures is essential for maximizing the growth, health, and productivity of Rohu populations. However, fluctuations in ambient temperatures and seasonal variations pose challenges to temperature management in aquaculture facilities. Implementing proactive management strategies can help mitigate the impacts of temperature stress and enhance the resilience of Rohu culture systems. Utilizing temperature control devices such as heaters, chillers, and shade nets helps regulate water temperatures within optimal ranges for Rohu culture. Monitoring temperature fluctuations and implementing corrective measures in response to environmental changes are essential for minimizing stress and promoting fish welfare. Choosing suitable locations for aquaculture facilities, such as areas with stable water temperatures

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and minimal temperature extremes, can reduce the risk of thermal stress and enhance production efficiency. Adjusting feed compositions and feeding regimes according to temperature requirements optimizes nutrient utilization and growth performance in Rohu.

High-protein diets with balanced amino acid profiles support metabolic functions and immune responses, enhancing fish resilience to temperature stress. Monitoring feed intake and adjusting feeding rates based on temperature fluctuations prevent overfeeding or underfeeding, ensuring optimal growth and nutrient utilization in Rohu populations. Maintaining water quality parameters, such as dissolved oxygen levels and ammonia concentrations, within optimal ranges minimizes stress and reduces the risk of disease outbreaks in Rohu culture systems. Regular health monitoring and disease surveillance facilitate early detection and intervention, preventing the spread of pathogens.