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Chapter 2

Ecological and aquacultural perspectives on Lates calcarifer (barramundi): A comprehensive review of biology, habitat, and sustainable farming practices

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Abstract: *Lates calcarifer* (family: Latidae), commonly known as barramundi, is a commercially and ecologically important fish species native to the Indo-Pacific region. This species is widely distributed in estuaries, coastal waters, and rivers of Southeast Asia, Australia, and parts of India. With its remarkable adaptability to both freshwater and saline environments, Lates calcarifer is a promising species for aquaculture, especially in tropical and subtropical regions. This review paper explores the ecological characteristics, life cycle, aquaculture practices, challenges, and potential for sustainable production of barramundi. Additionally, we examine the key environmental parameters that influence the growth, survival, and reproductive success of this species

Keywords: Lates calcarifer, Barramundi, Aquaculture, Sustainable production.

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2.1. Introduction

Barramundi is an economically significant fish species, both in wild fisheries and aquaculture. It is known for its fast growth rates, resilience in varying environmental

conditions, and high market demand (Allan & Burnell, 2006). The species has been the focus of aquaculture expansion, especially in countries like Australia, Thailand, and India. However, to optimize aquaculture systems and conserve natural populations, it is crucial to understand the ecology of *Lates calcarifer*, including habitat preferences, spawning behavior, feeding ecology, and environmental requirements.

2.2. Biology and Ecology of Lates calcarifer

Habitat and Distribution

Lates calcarifer is a euryhaline species, capable of surviving in both marine and freshwater environments. It is predominantly found in estuaries, rivers, and coastal zones, where salinity fluctuates. The species is widely distributed from the Persian Gulf to Papua New Guinea and is known for migrating between freshwater and brackish waters during different life stages (Blaber & Brewer, 2019). These migrations are often linked to spawning and environmental factors such as salinity and water temperature (Radhakrishnan & Nair, 2018).

2.3. Life Cycle and Reproductive Biology

Lates calcarifer has a complex life cycle with distinct stages, including juvenile, sub-adult, and adult forms. Spawning typically occurs in offshore waters during the rainy season, with larvae drifting in coastal and estuarine regions (Fielder & Hoque, 2020). The reproductive biology of barramundi has been extensively studied, and recent advances in controlled breeding and hatchery practices have improved the availability of juvenile fish for aquaculture systems (Hoang et al., 2020). Barramundi reaches sexual maturity at around 2-3 years of age, and the timing of reproduction is influenced by environmental conditions such as water temperature and salinity (Fielder & Hoque, 2020).

Feeding Ecology

Barramundi is a carnivorous species, with a diet primarily consisting of smaller fish, crustaceans, and invertebrates. Juveniles are more opportunistic feeders, while adults are predators that rely on a protein-rich diet for optimal growth (Radhakrishnan & Nair, 2018). In aquaculture, barramundi is typically fed formulated pellets that mimic the nutrient content of natural prey. The species exhibits a high feed conversion ratio, making it an attractive option for aquaculture (Allan & Burnell, 2006).

Environmental Requirements:

Optimal water temperature, salinity, dissolved oxygen (DO), and pH are essential for maintaining healthy barramundi populations. Barramundi thrives in water temperatures ranging from 25-30°C and salinities between 10-30 ppt (Sundar & Venkataramana, 2017). The species is sensitive to extreme variations in environmental parameters, making water quality management crucial in both wild habitats and aquaculture facilities. Dissolved oxygen levels above 4 mg/L are required for healthy growth and development (Ghosh & Pillai, 2019).

2.4. Aquaculture of Lates calcarifer

Production and Global Distribution

The global production of *Lates calcarifer* has been increasing steadily, with significant aquaculture operations in Australia, Southeast Asia, and India. The growth rate in aquaculture systems is significantly higher than in the wild, attributed to controlled environmental conditions, high-density stocking, and optimized feeding regimes (Kumar & Sharma, 2021). In India, barramundi farming has gained popularity due to its suitability to the tropical climate and its demand in domestic and international markets (Radhakrishnan & Nair, 2018).

Farming Systems

Several farming systems are used for barramundi aquaculture, including pond-based, cage-based, and recirculating aquaculture systems (RAS). These systems are designed to meet the specific environmental and dietary requirements of barramundi while minimizing disease risks and optimizing production. The use of RAS has become increasingly popular, offering greater control over water quality and reducing the environmental footprint of farming (Tiwari & Sharma, 2016). Cage farming in coastal areas is also common, providing a natural environment for the fish while controlling feeding and stocking densities (Ghosh & Pillai, 2019).

2.5. Challenges in Aquaculture

Despite its high aquaculture potential, there are several challenges, including disease management, water quality control, and high feed costs. Disease outbreaks, particularly bacterial infections like *Vibrio spp.*, and parasitic infestations such as *Argulus*, pose significant risks to production (Blaber & Brewer, 2019). Additionally, managing water quality in high-density farming systems is critical to maintaining healthy fish stocks.

Farmers are increasingly adopting integrated pest management strategies and improving biosecurity protocols to mitigate these challenges (Kumar & Sharma, 2021).

2.6. Sustainability in Barramundi Aquaculture

Sustainable aquaculture practices, including the development of alternative protein sources for fish feed (such as plant-based ingredients or insect meal), are being explored to reduce the reliance on fishmeal and minimize the environmental impact of barramundi farming (Reddy et al., 2019). Furthermore, integrating eco-friendly farming practices, such as polyculture systems, can help improve sustainability by reducing waste and promoting biodiversity (Fielder & Hoque, 2020). The use of RAS and innovative water management techniques further contributes to the sustainability of barramundi aquaculture (Tiwari & Sharma, 2016).

Conclusion

Lates calcarifer is a highly adaptable and economically important species for both wild capture fisheries and aquaculture. Continued research into the species' biology, ecological requirements, and sustainable farming practices is essential for optimizing production and minimizing the environmental impact of barramundi aquaculture. As the global demand for fish protein increases, *Lates calcarifer* holds significant potential for contributing to sustainable seafood production.

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