



Seasonal Dynamics of Water Quality Parameters Supporting *Lates calcarifer* in the Vasishta Godavari Estuary, India

Vijaya Deepika. R^{1*}, Sridhar Dumpala², Ramaneswari kakaralapudi³

^{1*}Research Scholar, Department of Zoology, University College of Science and Technology, Adikavi Nannaya University, Rajamahendravaram AP, India 533296.

²Department of Aquaculture, University College of Science and Technology, Adikavi Nannaya University, Rajamahendravaram AP, India 533296.

³Department of Zoology, University College of Science and Technology, Adikavi Nannaya University, Rajamahendravaram AP, India 533296.

***Corresponding Author:** Ramaneswari kakaralapudi

*Email: ramaneswari.zoo@aknu.edu.in

Abstract

The health and sustainability of estuarine fish species like *Lates calcarifer* depend on the stability and quality of their aquatic environment. This study investigates seasonal variations pre-monsoon, monsoon, and post-monsoon in key water quality parameters in the Vasishta Godavari estuary near Narasapuram, Andhra Pradesh, India, over two years (2013–2015). Parameters analyzed include temperature, pH, dissolved oxygen (DO), salinity, alkalinity, and total hardness. Results indicate that while most parameters fall within suitable ranges for *L. calcarifer*, distinct seasonal trends influence habitat conditions. Pre-monsoon months showed elevated temperatures and salinity; monsoon seasons introduced freshwater inflow, reducing salinity and pH; post-monsoon conditions stabilized water chemistry but increased nutrient concentrations. This seasonal analysis enhances our understanding of *L. calcarifer* ecobiology and emphasizes the importance of seasonal monitoring for sustainable estuarine fisheries and aquaculture practices.

Keywords: *Lates calcarifer*, water quality, estuary, seasonal variation, pre-monsoon, monsoon, post-monsoon, aquaculture, Vasishta Godavari

1. Introduction

Estuaries are ecologically rich zones shaped by the interaction of freshwater and seawater, creating gradients in physical and chemical parameters that directly affect aquatic biodiversity and productivity. *Lates calcarifer* (commonly known as barramundi or Asian seabass) is a high-value estuarine fish species renowned for its adaptability to varying salinity regimes and wide temperature tolerance (Partridge & Lymbery, 2008; FAO, 2010). Despite this adaptability, the physiological performance, reproductive success, and immune responses of *L. calcarifer* are known to be sensitive to fluctuations in water quality, especially those driven by seasonal cycles (Katersky & Carter, 2007).

The Vasishta Godavari estuary, part of the larger Godavari deltaic system in Andhra Pradesh, supports diverse fish communities and significant aquaculture activities. However, this estuarine system is heavily influenced by monsoonal rainfall, which contributes to sharp seasonal changes in hydrology and water chemistry (Sundaray et al., 2006). Understanding how these seasonal patterns affect water quality is vital for managing wild populations and aquaculture operations.

This study assesses six critical water quality parameters across three hydrological seasons: pre-monsoon (March–May), monsoon (June–September), and post-monsoon (October–February). The goal is to determine how seasonal changes affect habitat suitability for *L. calcarifer* and to provide a scientific basis for water quality management in the estuary.

2. Materials and Methods

2.1 Study Area

The Vasishta Godavari estuary is situated near Narasapuram (16.4333° N, 81.6833° E), in the West Godavari district of Andhra Pradesh, India. It lies at the interface of the Bay of Bengal and the Godavari River, forming a semi-enclosed brackish water environment with complex seasonal hydrodynamics.

2.2 Seasonal Classification

- **Pre-monsoon:** March–May
- **Monsoon:** June–September
- **Post-monsoon:** October–February

2.3 Data Collection

Water quality parameters were recorded monthly from March 2013 to February 2015:

- Temperature (°C)
- pH
- Dissolved Oxygen (DO, mg/L)
- Salinity (ppt)
- Alkalinity (mg/L as CaCO₃)
- Total Hardness (mg/L as CaCO₃)

In situ measurements were conducted following APHA (2012) guidelines using calibrated probes and titration methods.

2.4 Statistical Analysis

Descriptive statistics (mean, standard deviation, and variance) were computed. Seasonal trends were analyzed and compared against known optimal ranges for *L. calcarifer* (Boyd, 1998; FAO, 2010). Temporal graphs and variance analysis were used to detect seasonal shifts in water quality.

3. Results and Discussion

The water quality parameters data illustrated graphically in Figure I and VI

3.1 Seasonal Variation in Temperature

- **Pre-monsoon:** High temperatures (30–33°C)
- **Monsoon:** Moderate (28–31°C)
- **Post-monsoon:** Lowest (23–28.5°C)

Temperature ranged from 23°C (Dec 2014) to 33°C (May 2013), with a mean of 28.14°C. Temperature directly affects fish metabolism, feeding, and reproduction. While *L. calcarifer* can tolerate 20–36°C, optimal growth occurs between 26–32°C (Katersky & Carter, 2007). The observed data mostly fell within this range, suggesting favourable thermal conditions. However, peak summer temperatures may induce thermal stress.

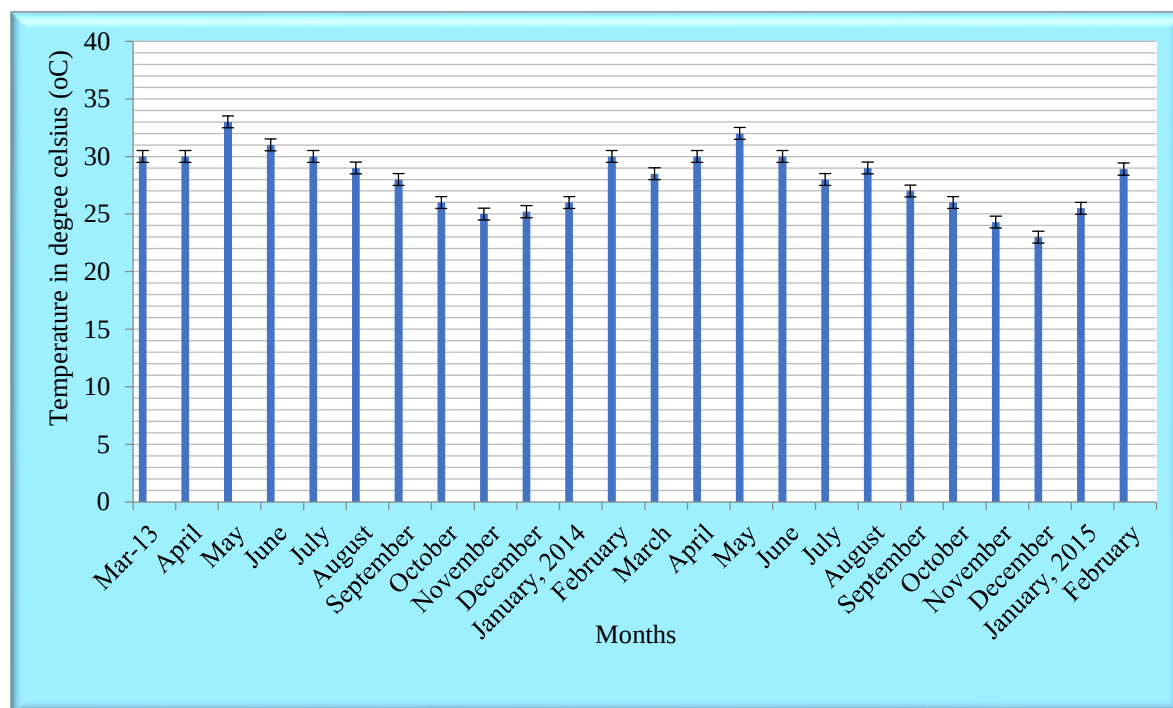


Fig. I. Monthly variation of in the temperature (°C) of sample water collected from Vasishta Godavari Estuary in and around Narasapuram.

3.2 pH Fluctuations

- **Pre-monsoon:** pH ~7.0–7.7
- **Monsoon:** Decreased pH (~6.7–7.1)
- **Post-monsoon:** Slightly alkaline (~7.2–7.8)

The pH values varied between 6.7 and 7.8, averaging 7.18, indicating slightly acidic to neutral waters. Seasonal declines in pH during the monsoon may be attributed to freshwater influx and organic decomposition (Sundaray *et al.*, 2006). The monsoonal freshwater influx dilutes buffering capacity and introduces organic matter, leading to slight acidification. However, all pH values remained within the acceptable range of 6.5–8.5 for *L. calcarifer* (FAO, 2010).

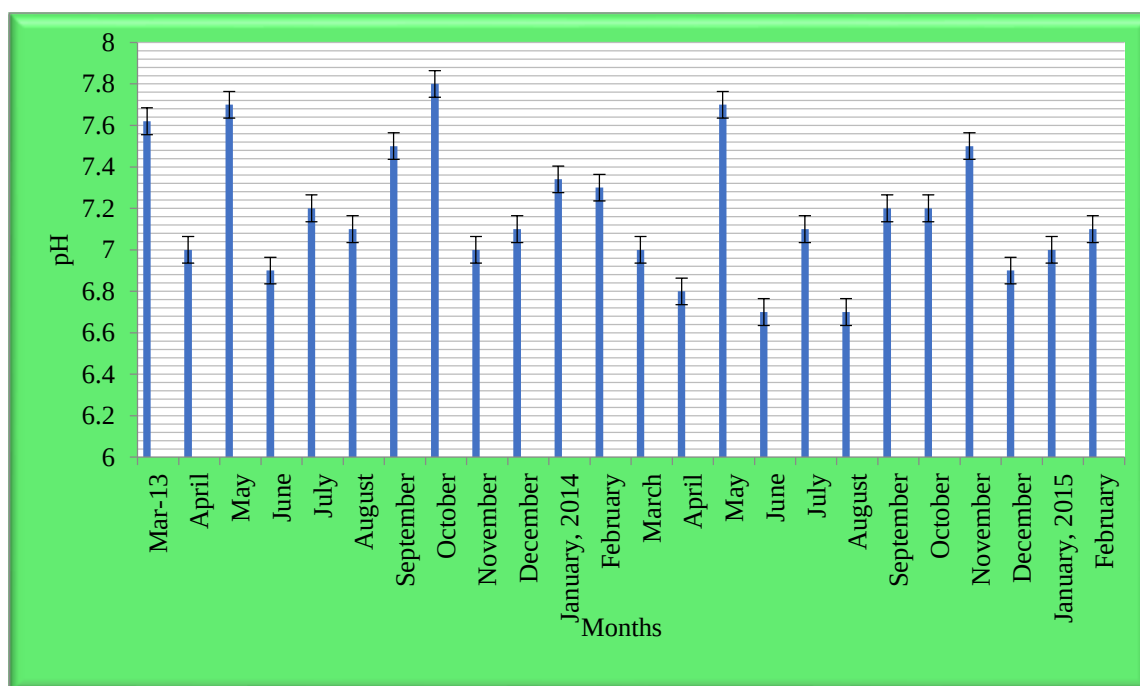


Fig.II. Monthly variations in the pH of sample water collected from Vasishta Godavari Estuary in and around Narasapuram.

3.3 Dissolved Oxygen (DO) Patterns

- **Pre-monsoon:** Lower DO (5.8–6.2 mg/L)
- **Monsoon:** Variable (5.2–6.7 mg/L)
- **Post-monsoon:** Higher DO (~6.3–6.9 mg/L)

DO levels ranged from 5.2–6.9 mg/L, with a mean of 6.15 mg/L. Higher DO during cooler post-monsoon months supports metabolic efficiency and disease resistance. DO never dropped below 5 mg/L, indicating suitable conditions for fish respiration throughout the year (Boyd & Tucker, 1998).

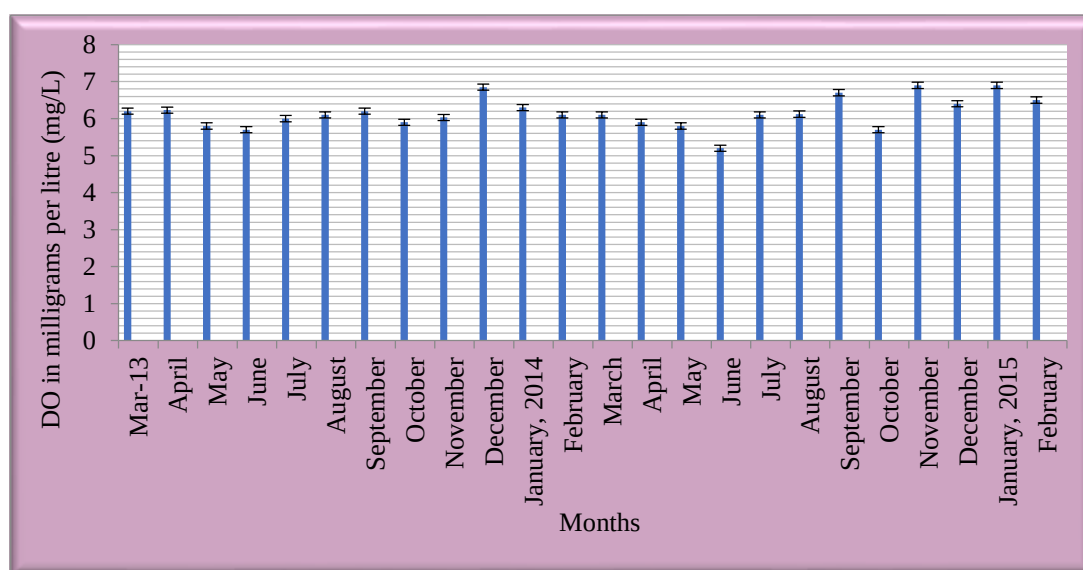


Fig.III. Monthly variations in the Dissolved oxygen (mg/L) of sample water collected from Vasishta Godavari Estuary in and around Narasapuram.

3.4 Salinity Trends

- **Pre-monsoon:** Elevated salinity (22–25.5 ppt) due to evaporation
- **Monsoon:** Diluted salinity (21–22 ppt) from freshwater input
- **Post-monsoon:** Stabilized (22–23 ppt)

Salinity varied between 21 and 25.5 ppt, averaging 22.48 ppt. *L. calcarifer* can tolerate wide salinity ranges (0–35 ppt) but prefers 10–25 ppt for optimal osmoregulation and growth (Partridge & Lymbery, 2008). Monsoon dilution poses minimal physiological stress due to the species' euryhaline nature.

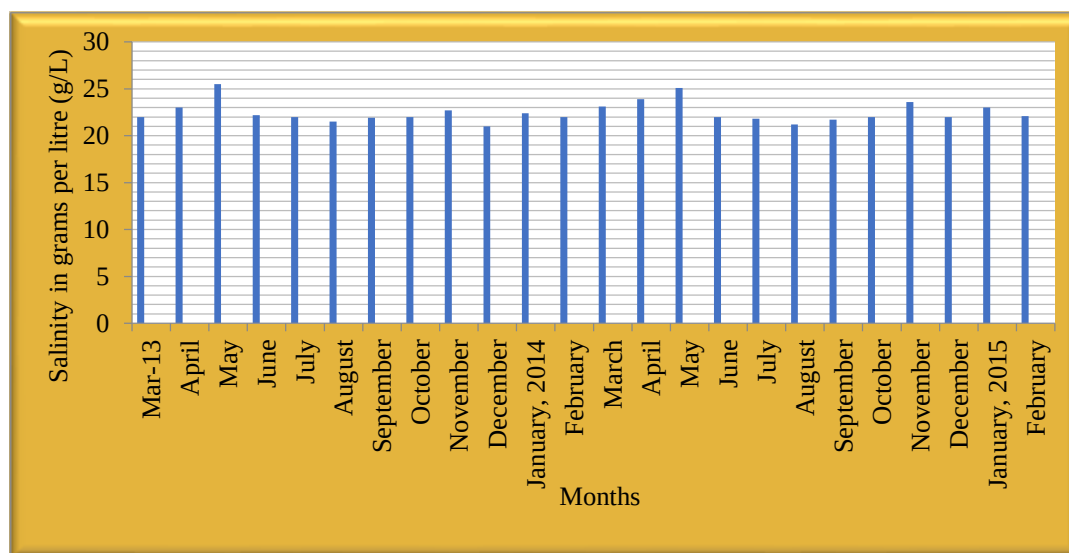


Fig. IV. Monthly variations in total salinity (ppt) of sample water collected from Vasishta Godavari Estuary in and around Narasapuram.

3.5 Alkalinity Patterns

- **Pre-monsoon:** High variability (192–380 mg/L)
- **Monsoon:** Peaked at 390.8 mg/L in June
- **Post-monsoon:** Declined to 135–225 mg/L

Alkalinity showed a wide variation (135–390.8 mg/L), with a mean of 215.36 mg/L and high variance. Alkalinity influences pH stability and ion balance. While high alkalinity supports buffering capacity, values above 300 mg/L may interfere with egg development and larval stages (Kumar *et al.*, 2018).

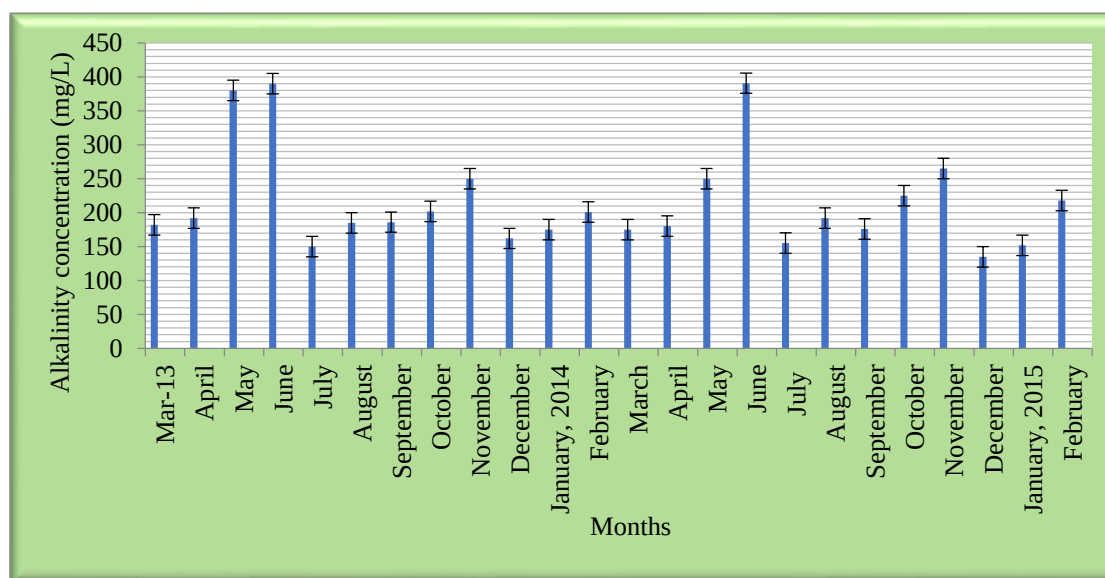


Fig. V. Monthly variations in total alkalinity (mg/L) of sample water collected from Vasishta Godavari Estuary in and around Narasapuram.

3.6 Total Hardness Fluctuations

- **Pre-monsoon:** Increased mineral load (4972–5564 mg/L)
- **Monsoon:** Highest values (5650 mg/L in June)
- **Post-monsoon:** Decreased (4060–4752 mg/L)

Total hardness levels were notably high (4060–5650 mg/L), averaging 4755.7 mg/L. While *L. calcarifer* can adapt to hard waters, extremely high hardness can affect egg development and metabolic efficiency (Boyd & Tucker, 1998). The consistently high hardness levels point to substantial mineral content, possibly from upstream geological sources and anthropogenic runoff.

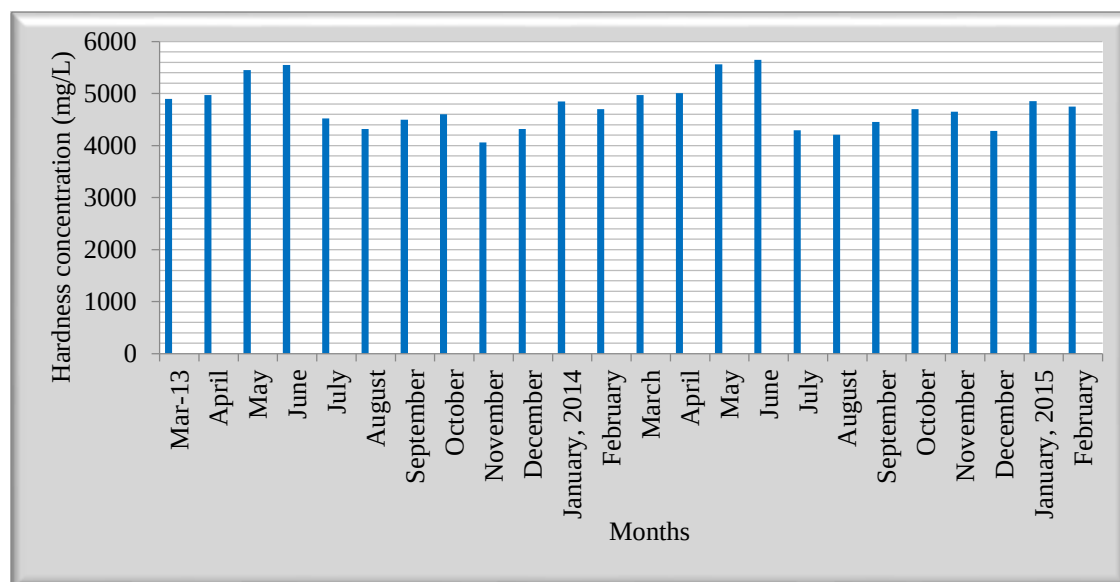


Fig. VI. Monthly variations in total hardness (mg/L) of sample water collected from Vasishta Godavari Estuary in and around Narasapuram.

4. Conclusion

The seasonal analysis of water quality parameters in the Vasishta Godavari estuary reveals a generally suitable environment for *Lates calcarifer* across all three hydrological seasons. Pre-monsoon months favor growth due to optimal temperature and salinity, while monsoon-induced dilution leads to transient stress due to decreased pH and increased alkalinity. Post-monsoon conditions provide a recovery period with improved dissolved oxygen and stabilized parameters. This study highlights the importance of seasonal water quality monitoring for estuarine aquaculture planning and fisheries conservation. The data serve as a baseline for future ecobiological studies and adaptive management strategies.

References

- APHA (2012). *Standard Methods for the Examination of Water and Wastewater*. 22nd Edition. American Public Health Association, Washington, D.C.
- Boyd, C.E. (1998). *Water Quality for Pond Aquaculture*. Alabama Agricultural Experiment Station, Auburn University.
- Boyd, C.E., & Tucker, C.S. (1998). *Pond Aquaculture Water Quality Management*. Springer Science & Business Media.
- FAO (2010). *Cultured Aquatic Species Information Programme: Lates calcarifer*. Fisheries and Aquaculture Division, Food and Agriculture Organization of the United Nations. [http://www.fao.org/fishery/culturedspecies/Lates_calcarifer]
- Katersky, R.S., & Carter, C.G. (2007). High-energy diets increase fillet yield but also susceptibility to environmental stress in barramundi (*Lates calcarifer*). *Aquaculture*, 273(1), 60–70.
- Kumar, S., Bera, A., & Ranjan, R. (2018). Water quality and fish health: A critical review. *Journal of Fisheries and Aquatic Studies*, 6(3), 10–15.
- Partridge, G.J., & Lymbery, A.J. (2008). Effects of salinity on growth and survival of juvenile barramundi (*Lates calcarifer*). *Aquaculture*, 278(1-4), 140–145.
- Ravichandran, S., Rameshkumar, G., & Muthukumaravel, K. (2016). Environmental parameters and fish diversity in estuarine waters of Tamil Nadu, Southeast India. *Indian Journal of Geo-Marine Sciences*, 45(7), 894–899.
- Sundaray, S.K., Panda, U.C., Nayak, B.B., & Bhatta, D. (2006). Multivariate statistical techniques for the evaluation of spatial and temporal variations in water quality of Mahanadi River–Estuarine system (India). *Environmental Geochemistry and Health*, 28(4), 317–330.