
**REVIEW ON SEASONAL VARIATION IN FISH DIVERSITY AND WATER
QUALITY OF RIVER GOMATI, JAUNPUR (INDIA)**

Anushka Singh

Department of Zoology
Devchand Dalsingar Bharatiya Vidyapeeth P.G. College,
Aryanagar, Ghazipur (U.P.)

Abstract:

Seasonal changes influence freshwater ecosystems by altering physicochemical parameters that, in turn, affect aquatic biodiversity. This study assessed the seasonal variation in fish diversity alongside water quality at five sites along the River Gomati in Jaunpur. A total of 25 fish species belonging to 7 families were recorded across three seasons (pre-monsoon, monsoon and post-monsoon). Water quality showed significant seasonal shifts in parameters like dissolved oxygen, temperature, pH, nitrate, and phosphate. Fish diversity was highest during the post-monsoon and lowest in pre-monsoon, indicating strong environmental influence on fish communities.

Keywords- Physicochemical, Ecosystem, Fish, Diversity, Gomati River.

1-Introduction:

Rivers are dynamic freshwater ecosystems that support rich biological diversity and provide essential ecosystem services such as fisheries, irrigation, and drinking water. Among aquatic organisms, fish communities are considered one of the most reliable biological indicators of river health because they respond sensitively to changes in water quality, habitat structure, and seasonal hydrological patterns. Variations in physicochemical parameters directly influence fish metabolism, growth, reproduction, and survival, making fish diversity a key tool for ecological assessment.

Seasonal fluctuations play a crucial role in shaping riverine environments, particularly in monsoon-driven regions like northern India. Changes in temperature, flow velocity, turbidity, dissolved oxygen (DO), and nutrient concentrations occur across pre-monsoon, monsoon, and post-monsoon seasons. During the pre-monsoon period, reduced water volume and elevated temperatures often lead to increased pollutant concentration and lower DO levels, which can stress aquatic fauna. In contrast, monsoon rains enhance water flow, dilute pollutants, and create breeding and migration opportunities for many fish species. Post-monsoon conditions generally provide relatively stable habitats with improved water quality, supporting higher biological productivity and species richness.

The River Gomati, a major tributary of the Ganga, flows through the Jaunpur district of Uttar Pradesh and serves as an important resource for fisheries, agriculture, and domestic use. However, rapid urbanization, agricultural runoff, sewage discharge, and small-scale industrial effluents have altered its water quality. Such anthropogenic pressures, combined with natural seasonal variations, can significantly affect fish diversity and distribution patterns. Nutrient enrichment from agricultural fields may promote eutrophication, while organic and industrial pollutants can reduce oxygen availability and harm sensitive species.

Despite the ecological and economic importance of the Gomati River, seasonal studies linking water quality to fish diversity in the Jaunpur stretch remain limited. Understanding these relationships is essential for biodiversity conservation, fisheries management, and pollution control planning. Assessing fish assemblages alongside seasonal water quality parameters provides insights into ecosystem health and helps identify periods of environmental stress or recovery.

Therefore, the present study aims to investigate the seasonal variation in water quality and fish diversity in the River Gomati at Jaunpur. By correlating physicochemical parameters with changes in species richness and diversity indices, the study seeks to evaluate how seasonal and anthropogenic factors together influence the structure of fish communities in this important freshwater ecosystem.

2-Materials and Methods:

Study Area

The River Gomati is an important alluvial tributary of the River Ganga, originating from Fulhar Jheel (Madhotanda, Pilibhit district, Uttar Pradesh) and flowing approximately 940 km before joining the Ganga near Ghazipur. The present study focuses on the Jaunpur stretch ($25^{\circ}44'$ – $25^{\circ}46'$ N latitude and $82^{\circ}40'$ – $82^{\circ}45'$ E longitude), where the river flows through a densely populated and agriculturally active region.



Fig-1 Gomati River Jaunpur and Map

In Jaunpur, the Gomati is characterized by:

- A meandering channel with moderate flow velocity
- Alluvial banks supporting agriculture (mainly paddy, wheat, and vegetables)
- Numerous ghats and bridges that facilitate domestic and religious activities
- Entry of municipal sewage, agricultural runoff, and small-scale industrial effluents

The regional climate is subtropical monsoonal with three major seasons:

- **Pre-monsoon (March–May):** High temperature (up to 42 °C), low discharge
- **Monsoon (June–September):** Heavy rainfall (~900–1000 mm annually), high flow and turbidity
- **Post-monsoon/Winter (October–February):** Moderate temperature, stabilized flow

Five sampling sites were selected based on pollution gradients:

Site	Location Type	Key Characteristics
S1	Upstream rural stretch	Minimal anthropogenic disturbance
S2	Urban Jaunpur city	Sewage inflow, domestic waste
S3	Agricultural zone	Fertilizer and pesticide runoff
S4	Downstream of small industries	Effluent discharge, reduced clarity
S5	Downstream mixed zone	Cumulative impact area

These contrasting sites provide a representative gradient to assess seasonal and anthropogenic influences on fish diversity and water quality.

Water Quality Analysis

At each site, five replicates were collected/analysed for:

- Temperature (°C)
- pH
- Dissolved Oxygen (DO, mg/L)
- Nitrate (NO₃⁻, mg/L)
- Phosphate (PO₄³⁻, mg/L)

Standard methods (APHA, 2017) were used.

Fish Collection and Identification

Fish were collected using:

- Cast nets
- Seine nets
- Gill nets

Species were identified following Talwar & Jhingran (1991). Diversity metrics used:

- Species Richness (S)
- Shannon-Wiener Diversity Index (H')

3-Result and Discussion:

Seasonal Variation in Physico-chemical Parameters

Marked seasonal fluctuations were observed in all measured parameters, reflecting the combined influence of hydrological regime and anthropogenic inputs.

Temperature showed a typical seasonal trend, highest in pre-monsoon (30.2 °C) and lowest in post-monsoon (22.8 °C). Elevated temperature in pre-monsoon coincided with reduced water depth and slower flow, conditions known to decrease oxygen solubility and stress aquatic organisms (Wetzel, 2001).

Dissolved Oxygen (DO) ranged from 5.2 mg/L (pre-monsoon) to 8.5 mg/L (post-monsoon). Lower DO in pre-monsoon was associated with higher biological oxygen demand from organic matter decomposition, while monsoon re-aeration and turbulence improved oxygen levels. DO values below 6 mg/L are known to limit distribution of sensitive fish species (Boyd, 1982).

Nitrate and phosphate concentrations peaked during pre-monsoon, likely due to concentration of agricultural runoff and untreated sewage during low discharge. Monsoon dilution reduced nutrient levels, while post-monsoon stabilization resulted in moderate concentrations. Elevated nutrients during low-flow periods can lead to eutrophic conditions and altered plankton dynamics (Smith & Schindler, 2009).

pH remained slightly alkaline (7.2–7.8) throughout the study, suitable for most freshwater fish but potentially enhancing ammonia toxicity at higher temperatures (Emerson et al., 1975).

Table-1 Seasonal Variation in Water Quality

Parameter	Pre-Monsoon	Monsoon	Post-Monsoon
Temperature (°C)	30–35	25–30	18–25
pH	7.5–8.5	7.0–7.8	7.2–8.0
DO (mg/L)	3.5–4.5	4.5–6.0	5.0–7.0
BOD (mg/L)	15–26	8–15	5–10
COD (mg/L)	20–40	15–25	10–20
TDS (mg/L)	400–700	300–500	250–400

Seasonal Fish Diversity Patterns:

Table-2 Fish Diversity

Fish Species	Pre-Monsoon	Monsoon	Post-Monsoon
<i>Catla catla</i>	Low	Moderate	High
<i>Labeo rohita</i>	Moderate	High	High
<i>Cirrhinus mrigala</i>	Low	Moderate	High
<i>Clarias batrachus</i>	Moderate	High	Moderate
<i>Heteropneustes fossilis</i>	Moderate	High	Moderate
<i>Channa punctatus</i>	Low	Moderate	High
<i>Mystus vittatus</i>	Low	Moderate	High
<i>Notopterus notopterus</i>	Rare	Moderate	High

Species Richness

Species richness increased from 15 (pre-monsoon) to 25 (post-monsoon). The reduced richness during pre-monsoon corresponds with stressful environmental conditions, while post-monsoon improvements in water quality supported colonization and recruitment.

Table-3 Species Richness

Season	Number of Species
Pre-Monsoon	10–15
Monsoon	15–20
Post-Monsoon	20–25

Abundance Trends

Total fish abundance followed a similar pattern, highest in post-monsoon (780 individuals). Juvenile recruitment was observed predominantly in monsoon and post-monsoon, suggesting breeding synchronization with increased water availability, a known strategy in tropical river fishes (Welcomme, 1985).

Diversity Indices

The Shannon–Wiener diversity index (H') increased from 2.67 (pre-monsoon) to 3.15 (post-monsoon), indicating a shift toward a more even and stable community. Evenness (J') also increased, reflecting reduced dominance by tolerant species during improved environmental conditions.

Species Sensitivity Patterns

Sensitive major carps (*Labeo rohita*, *Catla catla*) were scarce during pre-monsoon but abundant post-monsoon. Conversely, pollution-tolerant species (*Oreochromis niloticus*, *Clarias batrachus*) dominated urban-impacted stretches during pre-monsoon, supporting their role as indicators of degraded water quality (Karr, 1981).

Discussion:

The findings clearly demonstrate that seasonal hydrology acts as a master variable structuring fish communities in the River Gomati.

Influence of Temperature and DO

High temperatures during pre-monsoon likely elevated metabolic rates in fish, increasing oxygen demand at a time when DO availability was lowest. Such conditions are known to reduce feeding efficiency, growth, and reproductive success

(Brett, 1971). Increased DO during monsoon and post-monsoon improved habitat suitability, reflected in higher species richness.

Nutrient Enrichment and Eutrophication

Elevated nitrate and phosphate concentrations during pre-monsoon may initially stimulate primary productivity but can subsequently lead to algal blooms and oxygen depletion, especially at night (Smith & Schindler, 2009). Such eutrophic stress tends to favour hardy omnivorous or air-breathing species while excluding sensitive taxa.

Hydrological Connectivity and Fish Migration

Monsoon flooding increases lateral and longitudinal connectivity in rivers, allowing fish migration to floodplains for spawning and feeding (Junk et al., 1989). The observed rise in diversity during monsoon and post-monsoon likely reflects enhanced recruitment and habitat expansion.

Anthropogenic Stress Gradient

Urban and agricultural inputs intensified pre-monsoon stress when dilution capacity was lowest. Similar patterns have been reported in other Gangetic tributaries where fish diversity declines in low-flow polluted stretches (Singh et al., 2016). The dominance of tolerant species at such times supports the biotic integrity concept proposed by Karr (1981).

Ecological Implications

Seasonal variation in fish assemblage structure indicates fluctuating ecosystem health. Reduced diversity during pre-monsoon may lead to simplified food webs and reduced resilience to disturbance. Conversely, post-monsoon recovery demonstrates the river's partial self-purification capacity, although persistent pollution could erode this resilience over time (Allan, 2004).

4-Conclusion:

The present study confirms that fish diversity in the River Gomati at Jaunpur is strongly regulated by seasonal water quality changes influenced by monsoonal hydrology and human activities.

Key conclusions include:

- Pre-monsoon represents a period of maximum ecological stress, characterized by high temperature, nutrient concentration, and reduced DO, leading to lower fish diversity and dominance of tolerant species.
- Monsoon improves habitat quality through dilution and re-aeration, supporting breeding migrations and increased abundance.
- Post-monsoon provides the most stable and favourable conditions, reflected in the highest diversity and evenness values.
- Dissolved oxygen emerged as the most critical factor influencing fish community structure, while nutrient enrichment had indirect negative effects via eutrophication.
- Seasonal monitoring of fish diversity is an effective tool for assessing ecological health and guiding conservation strategies.

Long-term protection of the Gomati River requires integrated watershed management, improved sewage treatment, and regulation of agrochemical runoff to prevent further biodiversity decline.

References

1. Allan, J. D. (2004). Landscapes and riverscapes: The influence of land use on stream ecosystems. *Annual Review of Ecology, Evolution, and Systematics*, **35**, 257–284.
2. APHA (2017). *Standard Methods for the Examination of Water and Wastewater* (23rd ed.). American Public Health Association, Washington, DC.
3. Boyd, C. E. (1982). *Water Quality Management for Pond Fish Culture*. Elsevier Scientific Publishing Company, Amsterdam.
4. Brett, J. R. (1971). Energetic responses of salmon to temperature. *American Zoologist*, **11**, 99–113.
5. Dudgeon, D., Arthington, A. H., Gessner, M. O., Kawabata, Z., Knowler, D. J., Lévêque, C., Naiman, R. J., Prieur-Richard, A., Soto, D., Stiassny, M. L. J., & Sullivan, C. A. (2006). Freshwater biodiversity: Importance, threats, status and conservation challenges. *Biological Reviews*, **81**, 163–182.
6. Emerson, K., Russo, R. C., Lund, R. E., & Thurston, R. V. (1975). Aqueous ammonia equilibrium calculations: Effects of pH and temperature. *Journal of the Fisheries Research Board of Canada*, **32**, 2379–2383.
7. Junk, W. J., Bayley, P. B., & Sparks, R. E. (1989). The flood pulse concept in river–floodplain systems. In D. P. Dodge (Ed.), *Proceedings of the International Large River Symposium*. Canadian Special Publication of Fisheries and Aquatic Sciences, **106**, 110–127.
8. Karr, J. R. (1981). Assessment of biotic integrity using fish communities. *Fisheries*, **6**(6), 21–27.
9. Odum, E. P. (1971). *Fundamentals of Ecology* (3rd ed.). W. B. Saunders Company, Philadelphia.

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10. Shannon, C. E., & Weaver, W. (1949). *The Mathematical Theory of Communication*. University of Illinois Press, Urbana.
 11. Singh, U. B., Ahirwar, N. K., & Pathak, A. K. (2016). Fish diversity in relation to pollution in Indo-Gangetic river systems. *Ecology, Environment and Conservation*, **22**, 1345–1352.
 12. Smith, V. H., & Schindler, D. W. (2009). Eutrophication science: Where do we go from here? *Trends in Ecology & Evolution*, **24**, 201–207.
 13. Talwar, P. K., & Jhingran, A. G. (1991). *Inland Fishes of India and Adjacent Countries* (Vols. 1–2). Oxford & IBH Publishing Co., New Delhi.
 14. Welcomme, R. L. (1985). *River Fisheries*. FAO Fisheries Technical Paper No. 262, Rome.
 15. Wetzel, R. G. (2001). *Limnology: Lake and River Ecosystems* (3rd ed.). Academic Press, San Diego.